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VIA ELECTRONIC MAIL: eircomments@deltacouncil.ca.gov

Mr. Phil Isenberg
c/o Ms. Terry Macaulay, Interim Chief Deputy Executive Officer
Chair, Delta Stewardship Council
980 Ninth Street, Suite 1500
Sacrament, California 95814

Re: Yuba County Water Agency Comments on Draft Delta Plan EIR

Dear Mr. Isenberg:

Our firm represents Yuba County Water Agency (YCWA), which appreciates the opportunity to submit these comments on the draft environmental impact report (DEIR) for the draft Delta Plan.

YCWA has a hard-earned reputation as a responsible steward of its water supplies and has a proven conservation ethic that has led to repeated and successful collaborations with conservation groups and local, state and federal agencies. One of YCWA's collaborative efforts led to the landmark Lower Yuba River Accord. This award-winning settlement agreement ended 20 years of disputes and litigation by addressing water-supply and fishery needs in the lower Yuba River and has led to significant economic and environmental benefits for California. Higher instream flows for Chinook salmon and steelhead, and other fish and wildlife species, an unprecedented fisheries monitoring and evaluation program, reduced greenhouse gas (GHG) emissions and environmentally-responsible water transfers of hundreds of thousands of acre-feet of water are only a few of the Yuba River Accord's benefits. The Accord has been selected for the 2009 Governor's Environmental and Economic Leadership Award, the National Hydropower Association's 2009 Outstanding Stewards of America's Water Award and the Association of California Water Agencies' 2008 Theodore Roosevelt Environmental Award.

Based on YCWA's extensive experience, and a rigorous technical evaluation, YCWA provides the following comments on the DEIR. The enclosed technical report reflects YCWA's evaluation of the hydrological impacts of streamflow standards that would reflect a "more natural flow regime" like that proposed by the draft Delta Plan and the DEIR.[1] Based on that report we believe that the DEIR:

[1] The enclosed technical report is Grinnell/HDR 2012. HDR prepared the report's biological appendix, Appendix A.

(1) does not adequately analyze the impacts of the draft Delta Plan's flow-related proposals on fisheries, water supplies, groundwater conditions, hydroelectric generation or GHG emissions;

(2) does not adequately analyze the impacts of the draft Delta Plan's proposed restrictions on the exercise of water rights; and

(3) concludes, without supporting evidence, that the draft Delta Plan will generate more water transfers, rather than seriously discouraging them.

Most of these impacts derive from the devastating impacts on reservoir storage that implementation of a "more natural flow regime" would have, impacts that the DEIR does not analyze. We further believe that these impacts would result in serious social, economic and environmental consequences. YCWA also joins in the comments of the Northern California Water Association (NCWA), of which YCWA is a member.

1. The Yuba River Accord Implements The Coequal Goals

In the 2009 Delta Reform Act, the Legislature required that "the council shall develop, adopt, and commence implementation of the Delta Plan . . . that furthers the coequal goals" and defined the coequal goals to mean "two goals of providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem." (Water Code §§ 85054, 85300.) The Yuba River Accord already achieves these goals.

The Yuba River Accord is an integrated set of three agreements that: (1) establish streamflows to protect Chinook salmon and steelhead; (2) conjunctively manage YCWA's irrigation deliveries and Yuba County's groundwater; and (3) transfer a portion of the water released to satisfy the Accord's streamflow requirements to the State Water Project (SWP) and the Central Valley Project (CVP).[2] YCWA negotiated these agreements to resolve 20 years of controversy over the Yuba River's streamflows.

As discussed in more detail in the enclosed technical report (Grinnell/HDR 2012), YCWA, the Department of Fish and Game (DFG), the National Marine Fisheries Service (NMFS), the U.S. Fish and Wildlife Service (USFWS) and several environmental groups developed the Accord's streamflow schedules by identifying all available water and then:

(1) first, determined what streamflows would be optimal for the Yuba River's fisheries, while maintaining the basic "shape" of seasonal natural flows;

(2) second, established what streamflows would permit the survival of those fisheries in very dry years; and

(3) finally, set appropriately-staged intermediate streamflows.

[2]All of the agreements that constitute the Yuba River Accord are available on-line on YCWA's Web site at http://www.ycwa.com/projects/detail/8.

The resulting streamflow schedules dedicate to fisheries 70% to 189% of the inflow to YCWA's New Bullards Bar Reservoir in nearly all dry and critical years. The two Accord streamflow schedules within the lower Yuba River's optimal range for fisheries are expected to occur over a combined total of approximately 78% of water years. (Yuba River Accord draft EIR, p. 3-7 (Accord DEIR cited in Council's DEIR Appendix H, p. H-2).) The Accord thus provides crucial habitat for multiple life stages of Chinook salmon and steelhead, which also spend portions of their life cycles in the Bay-Delta.

The Accord provides water-supply reliability to Yuba County farmers that receive surface water from the Yuba River through conjunctive use of surface water and groundwater. As part of the Accord, YCWA negotiated conjunctive use agreements with seven of its member districts under which farmers will pump groundwater in some critical years in order to make 30,000 acre-feet (AF) of water available for streamflows to support fisheries. YCWA is able to defray farmers' costs for pumping that groundwater with the proceeds from its transfers to the SWP and CVP under the Accord's water purchase agreement. The Accord conjunctive use agreements also provide for funding the conversion from diesel-powered to electrical groundwater pumps under the Accord. It is this part of the Accord that will result in a reduction of fossil-fuel consumption and GHG emissions.

The Accord also contributes to addressing Delta environmental concerns and meeting statewide water demands. At many times since the Accord's implementation began, the increased Delta inflow attributable to it has significantly exceeded the concurrent Delta outflows. (Grinnell/HDR 2012.) Under the Accord's water purchase agreement, since its implementation began, the Accord has resulted in the dedication of about 300,000 AF to the Environmental Water Account and successor Delta fisheries programs. (*Ibid.*) Also under the water purchase agreement, YCWA provides at least 15,000 AF in dry years, and 30,000 AF in critical years, to SWP and CVP contractors, with YCWA potentially making additional transfer water available to those contractors in many years.

For these reasons, the Yuba River Accord achieves the coequal goals. Moreover, as discussed in more detail in the enclosed technical report, the Accord furthers each of the eight objectives that the Legislature declared, in Water Code section 85020, "are inherent in the coequal goals for the management of the Delta." (Grinnell/HDR 2012.) Delta Plan terms that would interfere with the Accord would undermine the coequal goals' implementation and cause environmental impacts.

2. Implementation Of A "More Natural Flow Regime" As Proposed By The Draft Delta Plan And The DEIR Would Have Devastating Impacts On The Reservoir Storage That Is Crucial To The Yuba River Accord

By its nature, implementation of a "more natural flow regime" would seriously impact reservoir storage because such a flow regime would require the release of substantial amounts of high winter and spring runoff that currently are stored in reservoirs. YCWA's existing reservoir storage is crucial to the Accord's implementation. YCWA's technical work shows that implementation of a "more natural flow regime" would have devastating impacts on YCWA's reservoir storage.

A. All Aspects Of The Yuba River Accord Depend On YCWA's Current Ability To Manage Reservoir Storage

The Accord relies on an allocation of all water available to YCWA. That water includes not just a given year's runoff, but also the water in New Bullards Bar Reservoir's carryover storage. (Grinnell/HDR 2012.) The enclosed technical report describes the importance of YCWA's reservoir storage in more detail.

B. Implementation Of A "More Natural Flow Regime" Would Devastate YCWA's Reservoir Storage And The Yuba River Accord

As explained in more detail in NCWA's comments, the draft Delta Plan and the DEIR contain no definition of the "more natural flow regime" that the DEIR identifies as a key element of the Council's proposed project. (DEIR, pp. 2A-39, 2A-68:7-8; 2A-68:25-26, 2A-73; 2A-87:35-36; 2A-93:27-31; 2A-95:35-36; 2B-6; 2B-11; 2B-15; 2B-16; 3-86:39 to 3-87:3; 3-94:27-30; 4-87:10-14; 4-87:23-24; 4-88:1-3; 4-88:21-25; 4-88:42 to 4-89:4; 4-89:40-41; 4-90:16-21; 4-91:6-8; 4-91:34-37; 4-94:36-38; 6-50:11-13; 6-64:39-41; 6-66:17; 25-10:36-38, 25-11:8-11.) This failure, in and of itself, demonstrates that the DEIR's analysis of the proposed project does not comply with CEQA because CEQA demands clarity in a project's description.

Notwithstanding the draft Delta Plan's and DEIR's failure to adequately define the "more natural flow regime" element of the proposed project, YCWA has analyzed the impacts that would occur on the Yuba River if one prominent version of such a flow regime were implemented. Specifically, YCWA has analyzed the impacts on flows and temperatures in the lower Yuba River, as well as New Bullards Bar storage, among other parameters, of implementing a flow regime that would rely on the releases of higher percentages of unimpaired flow as the fundamental regulatory principle. Specifically, as discussed in more detail in the enclosed technical report, YCWA has analyzed the impacts of implementing the Sacramento River and Delta outflow criteria that the State Water Resources Control Board (SWRCB) adopted in its August 3, 2010 report *Development of Flow Criteria for the Sacramento-San Joaquin Delta Ecosystem* (DFC Report). YCWA analyzed the impacts of implementing the following criteria stated in the SWRCB's DFC Report:

- 75% of unimpaired Delta outflow from January through June; and
- 75% of unimpaired Sacramento River inflow from November through June.

YCWA also analyzed the impacts of implementing such flow criteria at the reduced levels of 60% and 50% of unimpaired flow over the same time period.

YCWA's analysis indicates that implementation of the Sacramento River flow and Delta outflow criteria stated in the SWRCB DFC Report, as well as 60%-unimpaired-flow and 50%-unimpaired-flow scenarios, would have very serious impacts on New Bullards Bar Reservoir's storage. (Grinnell/HDR 2012.) As discussed in more detail in the technical enclosed report, in each of those scenarios: (1) New Bullards Bar Reservoir would be drained to its dead pool – so that no water would be available for any purpose – much more often; (2) the reservoir's cold-water pool would be depleted even more often; and (3) in multi-year droughts, the reservoir's storage would have its cold-water pool drained for a majority of the drought's duration. (Grinnell/HDR 2012.)

3. The Reservoir Storage Impacts Of Implementing A "More Natural Flow Regime" Would Cause Numerous Environmental Impacts That The DEIR Fails To Analyze

The impacts that implementing a "more natural flow regime" would have on reservoir storage would reverberate into significant impacts in many resource areas, impacts that the DEIR does not discuss.

A. Implementation Of A "More Natural Flow Regime" Would Have Significant Impacts On The Yuba River's Fisheries Because It Would Cause Water Temperatures Unsuitable For Listed Salmonids

The enclosed technical report shows that, if a "more natural flow regime" were implemented on the Yuba River, there probably would be significant increases in summer and fall water temperatures over baseline conditions. (Grinnell/HDR 2012.) As discussed in detail in that report, the reduced level of storage caused by a "more natural flow regime" would cause the temperature of New Bullards Bar Reservoir releases to rise about 10º Farenheit (F) in the summer and fall, causing downstream water temperatures in the lower Yuba River to reach the mid- to upper 70sºF in the summer and fall of dry and critically dry years.

Relative to baseline conditions, these impacts of implementing a "more natural flow regime" on Chinook salmon and steelhead would be very significant because, as discussed in the enclosed technical report: (1) YCWA has been able to maintain lower Yuba River suitable water temperatures under the Accord, including water temperatures lower than 65ºF during the juvenile spring-run Chinook salmon and steelhead over-summer rearing period, since 2006; and (2) the "more natural flow regime" would be expected to result in unsuitable water temperatures during the summer and fall of dry and critically dry years.

These water-temperature-based impacts on Chinook salmon and steelhead would be particularly dramatic in multi-year droughts. As discussed in more detail in the enclosed technical report, implementation of a "more natural flow regime" – at least if implemented as outlined in the SWRCB's DFC Report – would cause dramatic reservoir-storage impacts throughout a multi-year drought like the 1987-1992 drought. This means that the adverse water temperatures would impact multiple cohorts of Chinook salmon and steelhead and that some cohorts would be impacted by those conditions more than once.

The DEIR also fails to analyze any water-temperature impacts on listed salmonids that implementation of a "more natural flow regime" would have. The DEIR instead assumes that the SWRCB would implement a flow regime that "would represent a beneficial change for special-status fish." (DEIR, pp. 4-69 to 4-70.) This assumption is not adequate environmental analysis of the potentially devastating water-temperature impacts on listed salmonids that implementing a "more natural flow regime" would have.

B. Implementation Of A "More Natural Flow Regime" Would Cause Shifts In Streamflow Schedules That Would Significantly Impact Salmonids

The Accord's streamflow schedules are based on an allocation of all water available to YCWA and are intended to maximize the occurrence of optimal conditions for Chinook salmon and steelhead. Those streamflow schedules addressed, among other fishery concerns, the needs of spring-run Chinook salmon holding the lower Yuba River in the summer and the needs of Chinook salmon that migrate into the river and spawn in the fall.

The enclosed technical report demonstrates that implementation of a "more natural flow regime," in the form of the 75%-unimpaired-flow, 60%-unimpaired-flow or 50%-unimpaired-flow criteria, would essentially overturn the Accord's streamflow schedules, resulting in: (1) dramatic increases in spring streamflows; and (2) dramatic reductions in streamflows during the summer and fall, when steelhead hold, and Chinook salmon migrate and spawn, in the lower Yuba River. Moreover, implementation of such a flow regime would reduce streamflows to worst-case scenario "conference year" levels more often with much lower streamflows. As with water temperatures, implementation of a "more natural flow regime" would cause much worse streamflows throughout a multi-year drought.

The DEIR contains no analysis of the impacts on sensitive fisheries from these types of streamflow impacts that implementing at least some prominently-discussed variations of a "more natural flow regime" would cause. The DEIR assumes that the SWRCB would implement a "more natural flow regime" that would benefit sensitive fisheries. (DEIR, pp. 4-69 to 4-70.) The DEIR therefore fails to analyze the fishery impacts of a key element of the Council's proposed project.

C. Implementation Of A "More Natural Flow Regime" Would Have Severe Water-Supply And Groundwater Impacts

The enclosed technical report indicates that implementation of "more natural flow regimes" involving requirements that 75%, 60% and 50% of unimpaired runoff be released from November through June would have severe direct impacts on Yuba County water supplies and severe indirect impacts on the County's groundwater aquifers. Such streamflow requirements effectively would reverse the benefits that YCWA's operations have generated for Yuba County by reinitiating the serious groundwater overdrafts that previously occurred in the County.

As discussed in more detail in the enclosed technical report, the severe water-supply impacts would occur for two distinct reasons. First, as discussed above, implementation of the indicated streamflow criteria would dramatically reduce YCWA's storage of water in New Bullards Bar Reservoir. (Grinnell/HDR 2012.) Second, during the spring runoff season, YCWA's physical capacity to release water from reservoir storage would not be sufficient to both meet the streamflow requirements and also meet irrigation demands related to rice-field flood-ups and early tree and truck crop demands. (*Ibid.*) Because YCWA would be required to meet streamflow requirements, it would be forced to impose deficiencies on Yuba County water districts and their customers. The enclosed technical report demonstrates that a "more natural flow regime" would trigger delivery shortages that would occur in the springs of nearly all years, in total annual deliveries in a dramatically increased percentage of years and in dramatically increased percentages of demand. (*Ibid.*)

The DEIR fails to analyze in any realistic way the water-supply impacts that implementing a "more natural flow regime" would cause and, in this particular case, would cause to one of the most economically-challenged counties in California. The DEIR declares that such impacts would be less than significant, stating "because the availability of alternative water supplies and continued availability of Delta water supplies, there is no substantial evidence that this impact would be significant." (DEIR, p. 3-85.) Because YCWA already conjunctively manages limited groundwater supplies and is located upstream of the Delta where additional water cannot be imported to the Yuba River watershed, the facts demonstrate that there actually is no substantial evidence to support the DEIR's statement, at least in relation to this watershed.

Implementation of the "more natural flow regime" element of the Council's proposed project also would have significant groundwater impacts. The irrigation shortages that implementation of a "more natural flow regime" would trigger would force Yuba County water users to shift back to groundwater pumping. Southern Yuba County's groundwater was significantly overdrafted before YCWA began delivering surface water there, but now has recovered to historic levels. (DWR, Bulletin 160-09, *Cal. Water Plan, 2009 Update*, vol. 2, p. 8-20.) The delivery shortages that would occur during multiple-year dry cycles under a "more natural flow regime" would exceed the amount of groundwater that can be pumped without triggering overdraft, based on the fact that the amount of the shortages would be similar to the amounts that were historically pumped when the basin was overdrafted. (Grinnell/HDR 2012.)

D. Implementation of A "More Natural Flow Regime" Would Cause Significant Shifts In Hydroelectric Generation That Would Likely Force The Construction Of New Carbon-Based Generation Capacity

The enclosed technical report demonstrates that implementation of a "more natural flow regime" as represented by standards requiring the November-June release of 75%, 60% or 50% of unimpaired runoff would cause significant shifts in when YCWA generates hydroelectricity. (Grinnell/HDR 2012.) YCWA operates the 340-megawatt New Colgate Powerhouse, which is powered by storage releases from New Bullards Bar Reservoir and can operate as a peaking facility that generates power to meet peak electrical demands. The enclosed technical report shows that the modeled "more natural flow regimes" would significantly shift electrical generation at YCWA's New Colgate Powerhouse from the high-demand summer months to the low-demand spring months. As discussed in that report, those shifts would be most-pronounced in dry and critically dry years, when other hydroelectric facilities also would generate less power.

This pattern of impacts on YCWA's hydroelectric generation indicates that the draft Delta Plan's element of implementing a "more natural flow regime" would reduce California's existing capacity to generate electricity to meet peak summer demands, which would compel the construction of new generation plants to avoid power shortages and system instability. At a minimum, implementation of a "more natural flow regime" would require generation of additional electricity by carbon-producing facilities to compensate for the loss of hydropower. The DEIR recognizes such impacts as being significant. (DEIR, pp. 20-6 to 20-7, 20-13.) The DEIR, however, does not analyze this impact of the "more natural flow regime" element of the Council's proposed project. The DEIR also does not analyze the air quality and GHG impacts that would occur because new peak generation facilities would likely have to be fired by carbon-based fuel, and the impacts of constructing new transmission lines to get such power to customers. Because the DEIR fails to analyze these impacts of the Council's proposed project, the DEIR is inadequate.

4. Implementation Of Recommendation WR R5 Would Severely Impact Innovative Water Management Programs

Recommendation WR R5 states, in relevant part:

> The [SWRCB] . . . should require that proponents requesting a new point of diversion, place of use, or purpose of use that results in new or increased use of water from the Delta watershed should demonstrate that the project proponents have evaluated and implemented all other feasible water supply alternatives.

The DEIR states that it assumes that the draft Delta Plan's policies and recommendations will be successful. (DEIR, p. 2B-2.) YCWA therefore must assume that recommendation WR R5 would be implemented.

Implementation of such a recommendation could have prevented the Accord's development and later implementation. Water suppliers, including YCWA, sometimes must revise their operations in order to plan to meet their service areas' projected future demands. In some cases, this planning requires water suppliers to petition the SWRCB to change the points of diversion, places of use or purposes of use stated in their water-right permits and licenses. The Accord was one such example because YCWA needed to petition the SWRCB to change its water-right permits in order to, among other things, add the SWP's and CVP's points of diversion to enable the Accord's water transfers. Without any clear definition of what would qualify as a "feasible water supply alternative" under recommendation WR R5, the SWRCB's consideration of such water-right change petitions necessary to implement the Accord could have been subject to serious uncertainty and debate.

Implementation of recommendation WR R5 therefore would significantly discourage innovative water management programs like the Accord and, as a result, would have significant impacts to water supplies and fish and wildlife and their habitats, not to mention unforeseen impacts. Under that recommendation, water suppliers throughout the Central Valley would be discouraged – if not completely prevented – from implementing new measures to manage the water available to them to simultaneously meet streamflow standards based on new science and their service areas' future water-supply demands. Under that recommendation, such water suppliers would be subject to second-guessing about whether they had implemented vaguely-defined "feasible water supply alternatives." The SWRCB might reject the proposed water-right changes under that vague standard or, more likely, water suppliers would not seek to develop and implement new measures to address water-supply and fish and wildlife needs. Implementation of recommendation WR R5 therefore would inhibit California's progress toward the accomplishment of the coequal goals and impact water supplies and fisheries. The DEIR fails to analyze these impacts.

5. The DEIR Fails To Adequately Analyze The Proposed Project's Impacts On Water Transfers Because It States That The Proposed Project Would Facilitate More Transfers When It Actually Would Seriously Discourage Them And Possibly Cause Them To Stop

The DEIR states that implementation of the Council's proposed project includes water transfers and that the proposed project would result in more water transfers than the project alternatives. (DEIR, pp. 2A-23, 2B-10, 2B-15, 3-96.) Based on YCWA's extensive experience with transfers over the last 25 years, there is no evidence to support these DEIR conclusions. YCWA's experience indicates that the Council's proposed project would at least significantly impede water transfers.

A. YCWA's Transfer Experience Dates From The Late 1980s, Involves Transfers Of Over One Million Acre-Feet Of Water And Includes Development Of The Many Agreements Necessary To Implement The Yuba River Accord

YCWA began significant water transfers in 1987 and has transferred over 1,600,000 acre-feet of water. (See attached YCWA's enclosed water transfer table.) YCWA has transferred water to, among others, DFG, the Environmental Water Account, DWR, the state's Drought Water Bank, the Bureau of Reclamation, Contra Costa Water District and the City of Napa.

In YCWA's experience, the development and implementation of a water transfer usually involves certain key elements, such as:

- The use of water stored in a reservoir so that the water can be released on a schedule when it can be diverted downstream – usually in the Delta – consistent with many applicable environmental requirements;

- The negotiation of several agreements, such as an agreement with the water's buyer, possibly conveyance agreements with DWR or the Bureau of Reclamation and, for conjunctive use transfers, agreements with local water districts whose customers will pump groundwater rather than take the surface water that will be transferred;

- Consultations with state and federal fish and wildlife agencies to ensure that the transfer is consistent with applicable regulatory requirements; and

- The SWRCB's approval of a change petition to reflect the fact that a transfer frequently requires at least the addition of a point of diversion and place of use to the transferor's water-right permit or license, at least temporarily (See, e.g., Water Code §§ 1735-1737 (change requirements applicable to long-term transfers), 1725-1732 (one-year transfers).)

Based on YCWA's experiences, YCWA concludes that there is no support for the DEIR's statements that implementation of the draft Delta Plan would encourage water transfers because many of its policies and recommendations, if implemented, would significantly hamper transfers or, potentially, make them impossible to assemble.

B. Implementation Of A "More Natural Flow Regime" Would Significantly Reduce The Reservoir Storage On Which Water Transfers Depend

As discussed above and in the enclosed technical paper, implementation of a "more natural flow regime" as proposed by the draft Delta Plan and the DEIR would have very significant impacts on reservoir storage.

By significantly reducing the amount of water that could be retained in reservoir storage, implementation of a "more natural flow regime" would significantly reduce the physical asset that generally makes transfers possible. Reservoir storage is crucial because many water suppliers, like YCWA, legally may only transfer water that is surplus to the needs of their own service areas and their local communities demand nothing less. (See West's Water Code Appendix § 84-5.2.) Water stored in reservoirs helps to demonstrate that these standards can be met. In addition, reservoir storage allows cross-Delta transfers to be managed flexibly so that they can occur at times when the CVP and SWP pumps have sufficient capacity and applicable environmental rules allow the necessary export pumping. By severely reducing reservoir storage through implementation of a "more natural flow regime," the draft Delta Plan would significantly hamper water transfers, not encourage more of them as suggested in the DEIR.

C. The Draft Delta Plan's Vague Treatment Of Covered Actions Would Constrain Water Transfers

The draft Delta Plan and the DEIR suggest that the Council may seek to regulate the actions of water agencies outside of the Delta that make water available for transfers. The draft Delta Plan and the DEIR state that one-year water transfers will not be considered "covered actions" subject to the Council's consistency review authority. (Draft Delta Plan, p. 58; DEIR, p. 2A-4.) Those documents do not state similar limitations for longer-term transfers. For example, proposed policy WR P2 might be read to apply to all negotiations for agreements involved in transferring water through the Delta, even where those agreements involve parties located outside of the Delta. For example, the conjunctive use agreements between YCWA and its member districts that are part of the Accord make water available for transfer through the Delta. If proposed policy WR P2 would apply to such contracts and enable the Council to conduct consistency reviews of agreements negotiated among water suppliers located outside of the Delta, then the Council would create a significant disincentive for those suppliers to engage in cross-Delta transfers. The DEIR does not analyze how such a disincentive would affect the volume of transfers and therefore does not support its statements that the draft Delta Plan, as the proposed project, would result in more water transfers. (DEIR, pp. 2A-23, 2B-10, 2B-15, 3-96.)

D. The Draft Delta Plan's Policy WR P2 Would Complicate The Development Of Water Transfers And Probably Would Result In Fewer Transfers

The draft Delta Plan's proposed policy WR P2 would require that "all contracts . . . and agreements to export water from [or] transfer water through . . . the Delta except transfers for up to one year in length" be developed consistent with DWR policies on State Water Project contract amendments that require negotiations to be conducted in public before formulation of a project description under CEQA, except for: "Informal discussions prior to exchange of formal drafts and discussion of topics that are authorized to be kept confidential by law will not be subject to the public participation process."

Proposed policy WR P2's plain language seems to apply to all negotiations involved in developing a cross-Delta water transfer. If this is actually the case, then proposed policy WR P2 would be a significant impediment to developing such transfers. The DEIR fails to analyze proposed policy WR P2's effects on water transfers and therefore is inadequate.

In YCWA's experience, the development of a water transfer, particularly a long-term transfer, involves concurrent negotiations among many parties. It is unclear how proposed policy WR P2 would apply to all of the necessary discussions and negotiations, given that the only limits on the public participation policy stated in Appendix C2 of the Delta Plan are that it would not apply to "informal discussions prior to the exchange of formal drafts" or to "discussion of topics that are authorized to be kept confidential." It is unclear, under the cited DWR policy, what "formal drafts" are, but it is clear that public involvement would need to occur before formulation of a CEQA project description.

Application of such policies to long-term transfer negotiations would significantly discourage local agencies from participating in such transfers and would hinder such transfers' development. In essence, each and every public agency involved in the development of a long-term transfer would be subject to criticism and dispute as it would be working to develop a viable transfer. Such in-process criticism and dispute would discourage agencies from thinking creatively to optimize operations to make water available for transfers. Moreover, existing laws ensure significant opportunities for public input and comment well before public agencies approve long-term transfers. The Brown Act applies to involved local agencies' consideration of water transfer agreements. CEQA requires that any necessary environmental documents be subject to public review and comment. The SWRCB's change-petition process is public. It would be counterproductive to open all "formal" transfer negotiations to public participation and comment. It would be counterproductive and, in fact, counterintuitive not only for the agencies, but also for the public, given that the information available to discuss could be fragmentary and subject to significant adjustments based on concurrent discussions among the many parties.

YCWA believes that proposed policy WR P2 would reduce the number of long-term transfers and therefore there is no substantial evidence to support the DEIR's conclusion that implementation of the draft Delta Plan would facilitate more water transfers.

6. Conclusion

Implementation of the "more natural flow regime" that the draft Delta Plan and the DEIR identify as a key element of the Council's proposed project would have immediate and long-term adverse impacts on YCWA's reservoir storage and probably reservoir storage throughout the Delta watershed. While the occurrence of such impacts is merely logical because most variations on a "more natural flow regime" would require significantly higher releases of the winter and spring runoff that currently is stored, YCWA's technical analysis of the impacts that implementation of such a regime would have confirms what logic suggests. The impacts on YCWA's reservoir storage would ripple across numerous categories of environmental resources because that storage is the key physical asset that makes YCWA's implementation of the Yuba River Accord possible. The DEIR simply fails to analyze those environmental impacts of the Council's proposed project in any meaningful way and therefore does not comply with CEQA.

The DEIR also fails to adequately analyze the Council's proposed project because the DEIR fails to analyze the impacts of: (1) proposed recommendation WR R5, which would dramatically limit water suppliers' ability to modify their operations to address environmental and water-supply needs; and (2) proposed policy WR P2, which would significantly complicate, and discourage, water transfers, causing the Council's proposed project to reduce the number of water transfers, not increase them as the DEIR states.

In summary, YCWA finds that the DEIR fails to provide an analysis of the Council's proposed project that complies with CEQA.

Kind regards,

Ryan S. Bezerra

Enclosure
7021/Delta Council/L020212 Delta Plan EIR Comments Final
Cc: Curt Aikens, Yuba County Water Agency
Tim Quinn and Mark Rentz, Association of California Water Agencies
David Guy, Northern California Water Association

Yuba County Water Agency
Surface Water Sales
(Exclusive of Groundwater Substitution Sales)

YEAR	SOLD TO	Yearly	ACRE FEET	$/ACRE FOOT	TOTAL$	Type	
1984	Wilbur Jensen		200	3.50	700.00	1	Other
1984	Newhall/Kalfsbeek		1,500	3.50	5,250.00	1	
1985	Wilbur Jensen		400	10.55	4,220.00	1	
1985	Newhall/Kalfsbeek		350	10.55	3,692.50	1	
1986	Newhall/ Kalfsbeek		400	10.95	4,380.00	1	
1987	Dept of Water Resources		83,100	5/10.00	786,020.00	2	DWR/EWA
1988	Dept of Water Resources		135,000	11.50	1,552,500.00	2	
1989	Dept of Water Resources		90,000	45.00	4,050,000.00	2	
1989	Dept of Water Resources (DFG)	207,000	110,000	11.00	1,210,000.00	2	
1989	City of Napa		7,000	45.00	315,000.00	1	
1989	EBMUD Take or Pay	Not Delivered	60,000	45.00	2,700,000.00	1	
1990	City of Napa		6,700	45.00	301,500.00	1	
1990	Dept of Water Resources*	118,651	109,000	45.00	4,905,000.00	2	
1990	Tudor/Feather		2,951	7.50	22,132.50	1	
1991	State Water Bank		99,200	125.00	12,400,000.00	3	does not include 84,840 AF District pumping
1991	State Water Bank-F&G	134,700	28,000	50.00	1,400,000.00	4	
1991	City of Napa		7,500	50.00	375,000.00	1	
1992	State Water Bank		30,000	125.00	3,750,000.00	3	
1994	DWR		0	0.00	0.00		does not include 26,033 AF District pumping
1997	USBR for refuge water**	68,857	20,000	50.00	1,000,000.00	5	
1997	SAFCA for American River Fishery		48,857	50.00	2,442,850.00	5	
2001	CALFED Environmental Water Account	102,912	50,000	100.00	5,000,000.00	2	does not include 61,140 AF District pumping or our $15/AF share
2001	Dept of Water Resources		52,912	75.00	3,968,400.00	2	
2002	CALFED Environmental Water Bank		79,742	75.00	5,980,650.00		does not include 55,258 AF District pumping or our $15/AF share
2002	Dept of Water Resources	106,792	22,050	75.00	1,653,750.00		
2002	Contra Costa Water District		5,000	100.00	500,000.00		
2003	CALFED Environmental Water Account ***	70,000	65,000	85.00	5,525,000.00		
2003	Contra Costa Water District		5,000	68.75	343,750.00		
2004	CALFED Environmental Water Bank	100,487	100,000	88.00	8,800,000.00		
2004	EWA Dry Year Program		487	88.00	42,856.00		
2005	Environmental Water Account		4,601	80.00	368,104.00		6,068 total paid, but not recorded by DWR
2006	Environmental Water Account		9,245	70.00	647,150.00		actually moved through the Delta in April 2007
2007	Environmental Water Account		115,755	70.00	8,102,850.00		Sum of 2006 and 2007 equals 125,000AF
2008	Dept of Water Resources		117,211	85.97	10,076,375.00		does not include 48,875 AF District pumping or our $15/AF share
2009	Dept of Water Resources		91,100	72.42	6,597,500.00		does not include 88,900 AF District pumping or our $15/AF share
2010	Dept of Water Resources		75,645	66.57	5,035,875.00		does not include 66,211 AF District pumping or our $15/AF share
TOTALS			1,633,906		99,870,505.00		

* 9,909 AF also transferred for BVID not included (Lake Francis 1,765, Collins 8,144)
** 5,000 AF also transferred for BVID not included
***3,100 AF BVID conserved water transfer to Santa Clara not included

Also 2001 Water Rights Report indicates BVID transfer of 4,500 to DWR and 3,500 to EWA Confirmed by Page 3/20/2009

ANALYSIS OF POTENTIAL IMPACTS TO THE YUBA RIVER ACCORD AND LOWER YUBA RIVER PUBLIC TRUST RESOURCES IF THE SWRCB'S PROPOSED 2010 DELTA FLOW CRITERIA WERE IMPLEMENTED

January 2012

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ANALYSIS OF POTENTIAL IMPACTS TO THE YUBA RIVER ACCORD AND LOWER YUBA RIVER PUBLIC TRUST RESOURCES IF THE SWRCB'S PROPOSED 2010 DELTA FLOW CRITERIA WERE IMPLEMENTED

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List of Acronyms

CDFG	California Department of Fish and Game
cfs	cubic feet per second
CVP	Central Valley Project
Delta	Sacrament-San Joaquin Delta ecosystem
DWR	California Department of Water Resources
EWA	Environmental Water Account
NGO	Non-Governmental Organization
NMFS	National Marine Fisheries Service
PG&E	Pacific Gas and Electric Company
RMT	Yuba Accord River Management Team
SWP	State Water Project
SWRCB DFC	Delta flow criteria referred to in SWRCB Report
SWRCB Report	“Development of Flow Criteria for the Sacramento-San Joaquin Delta Ecosystem”
SWRCB	State Water Resources Control Board
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
YRDP	Yuba River Development Project
Yuba Accord	Lower Yuba River Accord

ANALYSIS OF POTENTIAL IMPACTS TO THE YUBA RIVER ACCORD AND LOWER YUBA RIVER PUBLIC TRUST RESOURCES IF THE SWRCB'S PROPOSED 2010 DELTA FLOW CRITERIA WERE IMPLEMENTED

January 2012

Stephen E. Grinnell, P.E.

EXECUTIVE SUMMARY

The 2010 SWRCB Delta Flow Criteria

On August 3, 2010, the State Water Resources Control Board (SWRCB) adopted Resolution 2010-0039, approving the report titled, "Development of Flow Criteria for the Sacramento-San Joaquin Delta Ecosystem" (SWRCB Report) (SWRCB 2010). The SWRCB Report identified new flow criteria for the Sacramento-San Joaquin Delta ecosystem (Delta) for the purpose of protecting public trust resources pursuant to California Water Code Section 85086 (of the 2009 Delta Reform Act. The Delta flow criteria in the SWRCB Report are referred to in this analysis as the "SWRCB DFC."

The SWRCB Report includes important qualifications. For example:

- The SWRCB Report states that an alternative question to, "How much water do fish need?" would be, "How much habitat of different types and locations, suitable water quality, improved food supply and fewer invasive species that is maintained by better governance institutions, competent implementation and directed research do fish need?" (SWRCB Report, page 1) This latter question is not addressed in the SWRCB Report.
- The SWRCB DFC are limited to protection of aquatic resources in the Delta, and do not have a regulatory or adjudicatory effect. The SWRCB Report did not consider balancing between potentially competing public trust resources, such as potential adverse effects of increased Delta outflow on the maintenance of coldwater resources for salmonids in reservoirs to maintain temperatures in Delta tributaries. When setting flow objectives with a regulatory effect, the SWRCB would undertake a comprehensive review of other public trust resources potentially affected by Delta outflow requirements, including the environment in the watersheds in which the Delta flows originate. (SWRCB Report, pages 2-3)

This analysis of implementation of the SWRCB DFC on the Yuba River assumes providing 75 percent of unimpaired Delta outflow from January through June, and 75 percent of Sacramento River inflow from November through June. Other percentages of unimpaired flow are also analyzed to understand the implications of a "more natural flow regime" as applied to the Yuba River.

The Purpose of this Analysis

This analysis does not address or comment on the merits of Water Code Section 85086, the SWRCB Report, or the SWRCB DFC. Rather, this analysis reviews: (1) how the Lower Yuba

River Accord (Yuba Accord) manages water resources for public trust resources on the lower Yuba River; and (2) how the Yuba Accord and public trust resources on the lower Yuba River (the 24-mile reach downstream from the U.S. Army Corps of Engineers' Englebright Dam) would be impacted if the SWRCB DFC were implemented. The analysis is also used to understand implications for impacts to the Yuba Accord and the Yuba River environment from regulatory actions that would require the Yuba River Development Project (YRDP) to release or bypass substantially greater amounts of water than currently released or bypassed to meet the Yuba Accord flows. To better understand the implications of effects of a regulatory action requiring greater Yuba River outflow to conform to the concept of providing "a more natural flow regime," other percentages of natural flow were also analyzed for this work, and a summary of those results is also provided in this report.

Synopsis of Analysis

The Yuba Accord reflects a comprehensive, scientifically justified plan for management of water resources to protect and enhance public trust resources on the lower Yuba River, and resource agencies have recognized that the continued implementation of the Yuba Accord is essential to the recovery of salmonids within the Central Valley. The Yuba Accord also achieves several of the statutory objectives of the 2009 Delta legislation for the lower Yuba River, and results in significant additional outflow to the Delta at times of concern as compared to previously implemented or contemplated regulatory standards. Implementation of the SWRCB DFC, or a substantial fraction of it, would affect available surface and groundwater supplies in Yuba County in a way that would have substantial adverse impacts on habitat for threatened spring-run Chinook salmon, fall-run Chinook salmon, and steelhead on the lower Yuba River by requiring increased Yuba River outflow in April and May at the expense of optimum flows and water temperatures for spawning and rearing from July through October.

The Yuba Accord

The Yuba Accord addresses numerous aspects of water resource management in Yuba County. Benefits provided by the Yuba Accord include beneficial flows and water temperatures for lower Yuba River aquatic resources; reliable irrigation water supply, groundwater storage and management practices; stable reservoir levels for recreation; water transfers for the CALFED Environmental Water Account (EWA) (or successor programs) and Delta exports; increased power generation, grid support and system regulation: and revenue for flood control and aquatic resources monitoring, evaluation and restoration.

The Yuba Accord includes a comprehensive, consensus-based fisheries agreement to protect and enhance aquatic habitat in the lower Yuba River. The Yuba Accord fisheries agreement was developed by a multi-agency resource team, including representatives from Yuba County Water Agency (YCWA); the California Department of Fish and Game (CDFG); the National Marine Fisheries Service (NMFS); the United States Fish and Wildlife Service (USFWS); and a group of non-governmental organizations (NGO), including the South Yuba River Citizens League, The Bay Institute and Trout Unlimited, among others. The Yuba Accord flow schedules were developed to optimize habitat conditions for threatened spring-run Chinook salmon, fall-run Chinook salmon, and steelhead for a range of hydrologic conditions.

The Yuba Accord was implemented on a pilot program basis during 2006 and 2007. Following the adoption of a comprehensive Environmental Impact Report ((to which there was no legal challenge), the Yuba Accord has been implemented on a long-term basis since the SWRCB approved petitions in 2008 to change the water right permits of YCWA to implement the Yuba Accord. There were no legal challenges to the SWRCB's order.

The NMFS Public Draft Recovery Plan for Anadromous Salmonids in the Central Valley (NMFS 2009) states: "… many of the processes and conditions that are necessary to support a viable independent population of spring-run Chinook salmon (page 115) [and a population of steelhead (page 140)] can be improved with provision of appropriate instream flow regimes, water temperatures, and habitat availability. Continued implementation of the Yuba Accord is expected to address these factors and considerably improve conditions in the lower Yuba River."

The Yuba Accord was selected by the Association of California Water Agencies for the 2008 Theodore Roosevelt Environmental Award for excellence in conservation and natural resources management, by the National Hydropower Association for the 2009 Outstanding Stewards of America's Waters Award for recreational, environmental and historical enhancement, and by Governor Schwarzenegger for the 2009 Governor's Environmental and Economic Leadership Award (which is the state of California's highest environmental award).

In summary, the Yuba Accord represents the comprehensive management of water supplies available to YCWA's Yuba River Development Project and local groundwater resources to:

- Maximize the number of years during which the range of optimum flow schedules are provided
- Preserve end-of-September reservoir storage in below normal to wet years to ensure enough water in storage to meet dry-year flow schedules
- Relate flow schedules to available water supplies
- Utilize groundwater supplies in dry years to augment instream flows and local irrigation supplies

As long as the Yuba Accord instream flows are maintained as intended, temperatures should be within acceptable ranges for lower Yuba River habitat. NMFS has identified continuation of the Yuba Accord as essential to support salmonid recovery in the Central Valley. Reservoir storage releases are essential to augment Yuba River watershed natural flow to achieve the habitat objectives of the Yuba Accord.

How Implementation of the SWRCB DFC Could Impact the Yuba Accord and Lower Yuba River Public Trust Resources

If implemented, the SWRCB DFC would modestly to severely degrade lower Yuba River habitat conditions, particularly water flows and temperatures, for threatened spring-run Chinook salmon, fall-run Chinook salmon and threatened steelhead on the lower Yuba River, and would significantly impair implementation of habitat enhancement activities under the Yuba Accord. Subject to additional information being developed through the Yuba Accord Monitoring and Evaluation Program, or other sources, the best-available science supports continued implementation of the Yuba Accord to preserve and enhance lower Yuba River habitat for threatened spring-run Chinook salmon, fall-run Chinook salmon, and steelhead.

As noted in the biological technical memorandum attached as Appendix A, if implemented, the SWRCB DFC would increase the occurrence of "Conference Years" from a 1-in-100-year probability to a 1-in-10-year probability, and reduce the following year's minimum instream flow requirements during 7 years of the 29-year simulation (or about a 24 percent increase). In addition, and coincident with the most severe flow-related impacts is the potential for significantly elevated water temperatures in the summer and early fall, due to low flows and increased water temperatures of reservoir releases, which would severely degrade the suitability of lower Yuba River water temperatures.

New Bullards Bar Reservoir Storage

One reason that the lower Yuba River is unique among Central Valley floor tributaries is that YCWA's New Bullards Bar Reservoir (on the North Yuba River) provides generally suitable water temperatures throughout the year, over a wide range of hydrologic and climitalogic conditions, for anadromous salmonids in the lower Yuba River (YCWA et al. 2007; RMT 2010). New Bullards Bar Reservoir is a deep, steep-sloped reservoir that persistently contains a large volume coldwater pool. The coldwater pool availability in New Bullards Bar Reservoir has historically been sufficient to accommodate year-round utilization of the lower outlet in New Bullards Bar Dam to provide cold water into Englebright Reservoir, and subsequently into the lower Yuba River (RMT 2010).

With the SWRCB DFC, a large portion of the water that is normally stored during the spring snowmelt season would be required as outflow and thus would not be stored at nearly the same rate as under baseline conditions. The loss of this fundamental storage mechanism is at the heart of all of the changes to hydrologic conditions that would occur with the SWRCB DFC.

Under the SWRCB DFC, in comparison to Baseline Conditions, the greatest seasonal increase in lower Yuba River flows would occur during spring, and particularly during April and May. Under the SWRCB DFC scenario, lower flows would occur during the summer and early fall of most dry and critical years. Also, under the SWRCB DFC scenario, reduced end-of-September storage in New Bullards Bar Reservoir would result in a shift to Yuba Accord flow schedules requiring lower minimum instream flows during 7 years of the 29-year evaluation period, including 6 of 10 dry years.

The SWRCB DFC scenario would result in New Bullards Bar Reservoir storage dropping to its dead pool on five occasions, and would approach a depleted state a sixth time, over the 29-year simulation period. Thus, the coldwater pool in New Bullards Bar Reservoir would be depleted in half of all dry and critical years (5 of 10) under the SWRCB DFC scenario.

Lower Yuba River Water Temperatures

It is estimated that New Colgate Powerhouse release water temperatures under the depleted pool condition associated with the SWRCB DFC scenario would be about 10 degrees warmer during the summer and fall than under the Baseline Condition. Higher release water temperatures under the SWRCB DFC scenario would coincide with substantially lower flows during the summer and fall of the driest years, exacerbating the water temperature conditions of the lower Yuba River, which could have the habitat impacts described in Appendix A.

Agricultural Water Supplies in Yuba County

Implementation of the SWRCB DFC would have very substantial effects on agriculture in Yuba County by causing shortages in irrigation deliveries during all but one year of the 29-year simulation period, and in such large quantities during several years that groundwater pumping would not be able to replace the shortages. Reductions in irrigation deliveries also would result in decreased flows in the upper section of the lower Yuba River during the spring, summer, and early fall, and increased water temperatures in the lower Yuba River. Even in wet years, irrigation deliveries would have to be restricted to meet the SWRCB DFC because there would not be enough release capacity from either New Bullards Bar Reservoir nor Englebright Reservoir to meet both the 75 percent of unimpaired flow requirement and irrigation water deliveries.

The Yuba South Subbasin historically was in overdraft until 1983, when surface water deliveries for irrigation in southern Yuba County began. The historical, pre-1983 annual amount of pumping in the Yuba South Subbasin is in the range of the irrigation shortages that would be imposed in drought years under the SWRCB DFC, suggesting that a reversion to groundwater supplies in those years by the four YCWA member units receiving irrigation deliveries from YCWA in the South Subbasin could lead again to overdraft of the groundwater basin. The YCWA member units in the Yuba South Subbasin are, Brophy Water District, Dry Creek Mutual Water Company, South Yuba Water District, and Wheatland Water District. Groundwater substitution transfers have totaled more than 200,000 acre-feet over the past three years (2008-2010). Given the amount of pumping needed to make up for shortages in surface water deliveries as a result of the SWRCB DFC scenario, it is likely that there would not be any groundwater substitution transfers from the Yuba South Subbasin. Irrigation delivery shortages would also occur for the three member units in the Yuba North Subbasin, limiting or eliminating groundwater substitution transfers from that subbasin.

New Bullards Bar Dam Recreation

New Bullards Bar Reservoir is a primary recreational boating destination in the northern Sierra Nevada mountain range. The reservoir is accessed at the Cottage Creek and Dark Day boat launch ramps. Cottage Creek is used for the majority of boating acess to the reservoir but becomes unusable when water levels drop below elevation 1,822 feet above mean sea level (storage of 450,000 acre-feet). Almost all of the camping and day use recreation for the reservoir is acessed at Cottage Creek. Lower storage levels in New Bullards Bar Reservoir as a result of the SWRCB DFC would severely limit recreational opportunites. The SWRCB DFC would result in reservoir levels below the elevation at which the boat ramp is usable in 6 out of 29 years, or about 20 percent of years. Under Baseline Conditions, the Cottage Creek boat launch ramp would be unusable in only 1 out of 29 years.

Yuba Accord Water Transfers

From 2007 to the end of 2010, the Yuba Accord has resulted in the transfer of over 610,000 acre-feet of water. Of this amount, about 300,000 acre-feet was transferred to the EWA and successor Delta fisheries programs. Because the SWRCB DFC scenario would shift the timing of water releases from the transfer window of the summer to the spring, when transfers typically do not occur, the result would be a substantial reduction and possibly elimination of surface water transfers in many years.

Water transfer revenues have been the source of funding for YCWA's contribution to the local share of flood protection facilities and for the $6 million study program administered by the Yuba Accord River Management Team to monitor and evaluate fisheries and the effectiveness of the Yuba Accord.

Hydroelectric Power Generation

Implementation of the SWRCB DFC would result in a shift of hydropower generation from the summer to the early spring. The current economic condition has resulted in easing of energy demands, which is most likely temporary. Historically, prior to this latest economic downturn, summer energy demands have strained the generation capacity in California, and springtime has been a time of lower demand. The SWRCB DFC would shift generation from the time that power generation is most needed to the time when it is least needed in California. The shift would be most pronounced in dry years, when hydropower across the state is reduced and there is less hydropower generation capacity in the power system. The SWRCB DFC scenario would result in a loss of an average of 11 percent of generation from the YRDP in the summers of all years, loss of an a average of almost 30 percent of generation in dry years, and loss of a substantial percentage of critical peaking, regulation, and stabilization provided for the Northern California grid during hot summer and fall peak demand periods. The shift in timing would result in other types of generation facilities having to be used to meet summer power demands, and it is very likely these other types of generating facilities would produce much more greenhouse gas emissions than hydropower.

Delta Inflow Contributions from the Yuba River

The stated purpose of the SWRCB DFC is to increase flows during the November through June time period to mimic the natural hydrograph. For the Yuba River watershed (similar to many Central Valley tributaries with storage facilities), water stored during the relatively high flow seasons of winter and spring is used to augment natural flows during other times of the year, and for much of the time in the driest years. The SWRCB DFC would result in substantially increased flows to the Delta from the lower Yuba River in a relatively narrow time period (e.g., April and May), but also would result in decreased flows and increased water temperatures during other periods. Under the Yuba Accord and the conjunctive use of surface and groundwater supplies, significantly higher outflow to the Delta from the Yuba River occurs in the times of greatest need. For example, **Table 1** lists the spring and annual increased Delta inflow due to the Yuba Accord when net Delta outflows were less than 10,000 cubic feet per second (as computed from Dayflow (IEP 2011)) for the first three years of the Yuba Accord. This table demonstrates that the Yuba Accord not only benefits the lower Yuba River, but also the Delta with increased flows during critical time periods.

Table 1. Yuba Accord Spring and Annual Increased Yuba River Outflow to the Delta 2007 through 2009

Year	**Spring (***March through June)* acre-feet	**Annual** acre-feet
2007	51,943	155,667
2008	74,824	198,597
2009	39,149	196,906

Lower Percentages of Unimpaired Flow on the Yuba River

In addition to analyzing the SWRCB DFC at 75 percent of unimpaired flow, we also analyzed scenarios with 60 percent and 50 percent of unimpaired flow as an outflow requirement of the Yuba River. These two scenarios are modeled using the same approach as the 75 percent of unimpaired flow for the SWRCB DFC scenario with the exception that the Yuba River outflow requirement from November through June is set at 60 percent of unimpaired Yuba River flow for the 60 percent scenario, and at 50 percent of unimpaired Yuba River flow for the 50 percent scenario.

The 60 percent unimpaired flow scenario results in the following effects:

- New Bullards Bar Reservoir storage is depleted in three additional years
- Accord flow schedules are shifted to lower flow schedules in 6 years (20 percent of years)
- Two additional Conference Years (3 total in 29 years or about 10 percent of years)
- Substantially elevated temperatures in the lower Yuba River in the summer of the Conference Years, which also have a depleted New Bullards Bar Reservoir coldwater pool
- Irrigation delivery shortages in the spring of all years and substantially increased annual shortages in 6 years (20 percent of all years)
- Power generation shifted from the summer to spring, with the greatest impact in drier years

While the 60 percent scenario results in the impacts listed above, increased Yuba River outflow is mostly limited to April and May, and much of this increased outflow is due to curtailment of the out-of-upper Yuba River Basin diversions to the Bear and American rivers. The resulting outflows for March and June are mixed, with the 60 percent scenario flows both slightly higher and slightly lower than Baseline Conditions, depending upon the year. The other months where the outflow requirement applies (November through February) see no substantial change in probability of outflow, and in some years, especially drier years, outflow is lower for the 60 percent scenario.

The 50 percent unimpaired flow scenario results in the following effects:

- New Bullards Bar Reservoir storage is depleted in three additional years
- Yuba Accord flow schedules are shifted to lower flow schedules in 5 years (20 percent of years)
- One additional Conference Year (2 total in 29 years or about 10 percent of years)

  Note – an additional year, 1988, is so close to becoming a Conference Year, within 2 percent of the Conference Year index threshold value, that it is likely that this year would also be a Conference Year
- Substantially elevated temperatures in the lower Yuba River in the summer of the Conference Years, which also have a depleted New Bullards Bar Reservoir coldwater pool
- Irrigation delivery shortages in the spring of all years and substantially increased annual shortages in 3 years (10 percent of all years)
- Power generation shifted from the summer to spring, with the greatest impact in drier years

While the 50 percent scenario results in the impacts listed above, the occurrence of increased Yuba River outflow is limited to mostly April and some increased outflow occurs in May of drier years, but the majority of this increased outflow is due to curtailment of the upper Yuba River watershed diversions to the Bear and American rivers. Under the 50 percent scenario, the effect on the YRDP is only for modest increased releases from New Bullards Bar Reservoir in April, but generally lower releases in the drier years of the rest of the months of November through June. Effectively the 50 percent scenario outflow requirement for these other months (except April) results in lower flows in wetter years and mixed results of modest increases or decreases for drier years.

In summary, for the 50 percent scenario, the effect on the YRDP is to impact New Bullards Bar Reservoir storage, depleting it to below 300,000 acre-feet of storage in three years, shifting the Yuba Accord flow schedules to lower flows in 5 years, and resulting in at least one and more likely two additional Conference Years compared to Baseline Conditions, without a significant increase in Delta inflow, other than slight increases in April, but with slightly lower inflow at other times.

Conclusion

The SWRCB DFC would degrade flow and temperature conditions in the summer and early fall of the driest years, reversing the habitat achievements of the Yuba Accord. Through a science-based, collaborative process of numerous stakeholders, the Yuba Accord was developed and implemented to comprehensively manage surface and groundwater resources to preserve and enhance lower Yuba River habitat for threatened spring-run Chinook salmon, fall-run Chinook salmon, and threatened steelhead, and provide for other beneficial uses and public trust resources. In addition, the Yuba Accord has resulted in significantly higher outflow to the Delta when inflows to the Delta are low. Changing operations under the Yuba Accord to implement the SWRCB DFC would unravel many of the advances made with the Yuba Accord.

1. INTRODUCTION

Delta Reform Act

On August 3, 2010, the State Water Resources Control Board (SWRCB) adopted Resolution 2010-0039 approving the report titled “Development of Flow Criteria for the Sacramento-San Joaquin Delta Ecosystem” (SWRCB Report). The SWRCB Report identified new flow criteria for the Sacramento-San Joaquin Delta ecosystem (Delta) for the purpose of protecting public trust resources pursuant to California Water Code Section 85086.

The SWRCB Report has raised the question “What would happen to upstream systems if these criteria were imposed on water rights holders as regulatory standards?” The answer is that upstream water rights holders and water storage and conveyance operators would be required to make substantial changes to their standard operations and forego substantial amounts of diversions to achieve the Delta inflows identified as the Delta flow criteria (SWRCB DFC) in the SWRCB Report.

The analysis contained herein examines potential impacts the SWRCB DFC could have on lower Yuba River water-related resources if they were implemented as a regulatory standard. The analysis also includes examination of impacts of variations of the SWRCB DFC as regulatory standards.

1.1 THE SWRCB DELTA FLOW CRITERIA

The California State Legislature required the SWRCB to develop the SWRCB DFC, and directed the SWRCB to submit the SWRCB DFC to the Delta Stewardship Council (DSC) within 30 days of completion to “inform planning decisions for the Delta Plan.” The Delta Plan has the co-equal goals of “water supply for California” and “protecting, restoring, and enhancing the Delta ecosystem.” However, the SWRCB Report does not appropriately address “water supply for California,” nor does the SWRCB Report attempt to balance competing demands for water supply.

The SWRCB Report states “Recent Delta flows are insufficient to support native Delta fishes for today’s habitats. Flow modification is one of the immediate actions available although the links between flows and fish response are often indirect and are not fully resolved. Flow and physical habitat interact in many ways, but they are not interchangeable.” Further, the SWRCB Report attempts to identify the quantity of Delta flow required to “preserve the attributes of a natural variable system to which native fish species are adapted.”

The SWRCB Report identifies criteria, expressed as percentages of natural (unimpaired) flows, as surrogates for the general magnitude and timing of a natural flow regime. The SWRCB DFC include the following:

- 75 percent of unimpaired Delta outflow from January through June
- 75 percent of unimpaired Sacramento River inflow from November through June
- 60 percent of unimpaired San Joaquin River inflow from February through June

Because the Yuba River contributes to Sacramento River inflow to the Delta and to Delta outflow, the first two flow criteria are the primary points of the analysis contained herein.

1.2 OVERVIEW OF THE YUBA ACCORD

The purpose of the analysis contained herein is to evaluate the potential impacts that the SWRCB DFC would have on the multiple benefits to lower Yuba River water-related resources provided by the Yuba River Development Project (YRDP) and the SWRCB-approved Lower Yuba River Accord (Yuba Accord). On March 18, 2008, the SWRCB approved petitions to implement a consensus-based, comprehensive program to protect and enhance 24 miles of aquatic habitat in the lower Yuba River, extending from Englebright Dam downstream to the river's confluence with the Feather River near Marysville.

The Yuba Accord consists of a Fisheries Agreement, Conjunctive Use Agreements, and a Water Purchase Agreement. Under the Conjunctive Use Agreements, Yuba County Water Agency (YCWA) with seven of its Member Units receiving surface water supplies for irrigation, implement programs to conjunctively use available surface water and groundwater supplies to ensure that local water supplies are not reduced to implement the Yuba Accord. Under the Water Purchase Agreement between YCWA and the California Department of Water Resources (DWR), YCWA transfers water, including water made available by the instream flow schedules in the Fisheries Agreement, to DWR, and DWR makes payments to YCWA that are, in turn, used to make payments to the River Management Fund, to Member Units under any Conjunctive Use Agreements, and to fund flood management and water supply projects in Yuba County. Additionally, an agreement with Pacific Gas and Electric Company (PG&E) amending the PG&E/YCWA Power Purchase Contract has been executed so that YCWA can implement the Fisheries Agreement, Water Purchase Agreement, and Conjunctive Use Agreements. Together, this package of agreements provides more water for instream flows and greater reliability for both instream and consumptive uses than would have been possible without the agreements.

Flows in the lower Yuba River are maintained in accordance with the Fisheries Agreement. The flow schedules in the Yuba Accord were developed by the Lower Yuba River Accord Technical Team, a technical working group including representatives from YCWA, National Marine Fisheries Service (NMFS), U.S. Fish and Wildlife Service (USFWS), California Department of Fish and Game (CDFG), and a group of the non-governmental organizations (NGO) including Trout Unlimited, American Rivers, The Bay Institute, and South Yuba River Citizens League.

The Yuba Accord flow schedules were implemented with SWRCB approval on a pilot program basis during 2006 and 2007, and continue to be implemented on a long-term basis since the SWRCB approved petitions to change the water right permits of YCWA that were necessary to implement the Yuba Accord in 2008.

Thus, the Yuba Accord coordinates three interrelated beneficial uses of water: (1) instream flows; (2) water for local irrigation needs, including conjunctive use of groundwater; and (3) water for downstream uses, primarily Delta flows and exports.

Although the Yuba Accord results in flow standards for the lower Yuba River that YCWA must meet with operations of New Bullards Bar Reservoir, the classic metric of minimum instream flows was abandoned for the Yuba Accord and a "full utilization of available water" metric replaced the minimum instream flow approach. This approach allocated all available water to the Yuba Accord flow schedules in an attempt to optimize habitat conditions for salmonids. The Yuba Accord flow schedules contain large volumes of water when compared to runoff, especially in the drier years. Only about 20 percent of the runoff to the lower Yuba River comes from sources other than New Bullards Bar Reservoir releases in dry and critical years. This other flow mostly occurs in short intense winter and spring runoff events that provide little help in meeting the Yuba Accord flows for the remainder of the year. **Figure 1.2-1** shows the Yuba Accord flow schedule annual volumes as a percentage of New Bullards Bar Reservoir inflow (including diversions to the reservoir from the Middle Yuba River) for the period from water year 1970 to 2009. This chart demonstrates that in drier years, most of the inflow of New Bullards Bar Reservoir is dedicated to meeting the Yuba Accord flows, resulting in substantial outflow of the Yuba River as a percentage of inflow. This comparison demonstrates the substantial commitment of water and YRDP facility operations to provide beneficial use of water for environmental purposes as a centerpiece of the Yuba Accord.

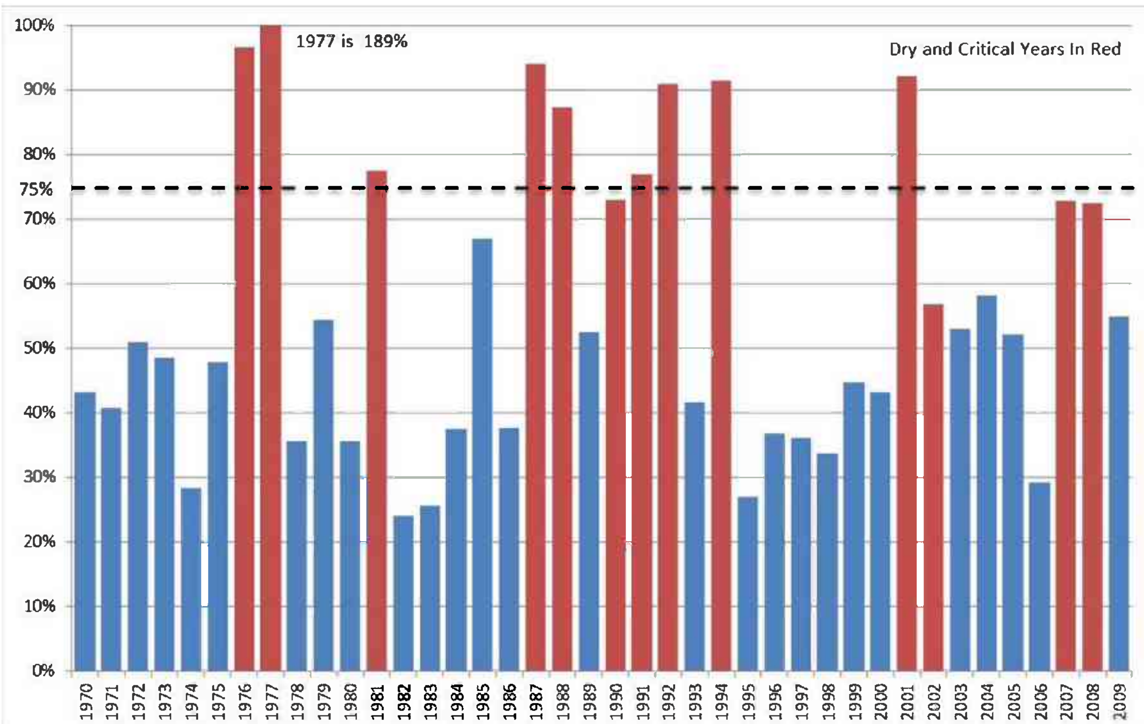

Figure 1.2-1. Yuba Accord Minimum Instream Flow Volume as a Percentage of New Bullards Bar Reservoir Total Inflow (including Diversions from the Middle Yuba River to New Bullards Bar Reservoir)

1.2.1 The Yuba Accord Advances the Objectives of the 2009 Delta Reform Act

The Yuba Accord advances many of the objectives of the 2009 Delta Reform Act, including improvement of salmonid spawning and rearing habitat on the lower Yuba River, implementing a state and local cooperative initiative, and achieving the co-equal goals providing a more reliable water supply and protecting, restoring, and enhancing the Yuba River ecosystem.

In the 2009 Delta Reform Act, the Legislature adopted eight objectives for management of the Delta and its ecosystem. In 2008, YCWA began implementing the Yuba Accord under agreements with CDFG, environmental groups, state and federal water contractors, and local water districts, and as required by a SWRCB order amending YCWA's water right permits to include the Yuba Accord's streamflow requirements.

The Yuba Accord implements the Legislature's eight Delta objectives, as stated in Water Code section 85020, to the extent that they apply to the resources affected by the Yuba Accord. Those objectives, and the manner in which the Yuba Accord implements them, are as follows:

> *(a) Manage the Delta's water and environmental resources and the water resources of the state over the long term.*

The Yuba Accord describes streamflow requirements for the lower Yuba River through 2016. Those requirements are designed to maximize the benefit of water managed by YCWA for lower Yuba River Chinook salmon and steelhead. YCWA's Federal Energy Regulatory Commission (FERC) license will expire in 2016 and be renewed either at that time or shortly after. YCWA's renewed FERC license will incorporate streamflow requirements. The Yuba Accord, and the scientific information from studies funded by YCWA, using monies from water transfer revenues under the Accord, will provide the basis for considering streamflow requirements in a new FERC license.

The Yuba Accord also provides a basis for managing streamflows in the Yuba River and Yuba County's groundwater basin conjunctively to support the county's agricultural industry. Under conjunctive use agreements with local water districts, YCWA will use funds from its water transfers under its Water Purchase Agreement to defray farmers' costs for groundwater pumping when maintaining Yuba River streamflows for Chinook salmon and steelhead requires reductions in agricultural deliveries. Those water transfer revenues also will enable YCWA to monitor Yuba County's groundwater basin to ensure that agricultural pumping is sustainable and to assist farmers in shifting from diesel to much cleaner electrical pumps.

> *(b) Protect and enhance the unique cultural, recreational, and agricultural values of the California Delta as an evolving place.*

By increasing streamflows from the Yuba River at critical times, implementation of the Yuba Accord increases Delta inflows at times of need. In the three years of Yuba Accord implementation –2007, 2008, and 2009 – the Yuba Accord increased Delta inflow in the spring by an average of 55,000 acre-feet. These increased Delta inflows helped maintain water quality necessary to support municipal, industrial, and agricultural land uses that depend on in-Delta diversions.

> *(c) Restore the Delta ecosystem, including its fisheries and wildlife, as the heart of a healthy estuary and wetland ecosystem*

The implementation of the Yuba Accord's streamflow requirements have improved conditions in the lower Yuba River for Chinook salmon and steelhead that migrate from the Yuba River through the Delta to the ocean and back through the Delta to spawn. NMFS's Public Draft Recovery Plan for Anadromous Salmonids in the Central Valley (NMFS 2009) recognizes how the Yuba Accord has improved conditions for those fish.

> *(d) Promote statewide water conservation, water use efficiency, and sustainable water use*

Implementation of the Yuba Accord improves the efficiency and sustainability of water use in the Yuba River, Yuba County, and statewide.

The Yuba Accord allocates all water available to YCWA to meet both fishery needs in the lower Yuba River and consumptive needs in Yuba County. It incorporates conjunctive use arrangements and monitoring to sustainably manage Yuba County's groundwater supplies so that they can be used in dry and critical years when YCWA's surface water deliveries may be constrained to maintain biologically appropriate streamflows in the Yuba River. The Yuba Accord's conjunctive use terms ensure that groundwater pumping does not result in an overdraft similar to the overdraft that existed in southern Yuba County before YCWA began delivering surface water to that area in the mid-1980s.

The Yuba Accord's Water Purchase Agreement improves the efficiency of statewide water supplies by allocating water released from the Yuba River as water transfer to State Water Project (SWP) contractors and, through exchange agreements, to Central Valley Project (CVP) contractors. The Yuba Accord enables approximately 60,000 acre-feet of water to be allocated to SWP and CVP contractors in all water years to repace supplies lost through environmental flow action in the Delta. The water purchase agreement enables additional transfers from YCWA to the SWP in dry and critical years, increasing combined SWP/CVP supplies by 70,000 acre-feet a year or more.

> *(e) Improve water quality to protect human health and the environment consistent with achieving water quality objectives in the Delta*

As discussed above, implementation of the Yuba Accord increases streamflows into the Delta. These increased streamflows help to address any issues created by municipal, industrial or agricultural discharges into the Delta.

> *(f) Improve the water conveyance system and expand statewide water storage*

As discussed above, the Yuba Accord's water purchase agreement provides water to the CVP and SWP in all years and makes additional water available to those projects in dry and critical water years. YCWA provides this water – after that water enhances conditions for Chinook salmon and steelhead in the lower Yuba River – by re-operating its New Bullards Bar Reservoir to maximize the efficiency of its storage capacity. The Yuba Accord accordingly expands statewide water storage by improving the efficiency of New Bullards Bar Reservoir's 966,000 acre-feet of storage capacity.

> *(g) Reduce risks to people, property, and state interests in the Delta by effective emergency preparedness, appropriate land uses, and investments in flood protection*

The Yuba Accord does not affect land uses, emergency preparedness or flood protection in the Delta. The proceeds from the Yuba Accord's water transfers, however, have enabled YCWA to contribute to flood management improvements in Yuba County. For example, those transfer revenues enabled YCWA to contribute to the $78 million local cost share for the recently completed Feather River setback levee.

> *(h) Establish a new governance structure with the authority, responsibility, accountability, scientific support, and adequate and secure funding to achieve these objectives*

The Yuba Accord incorporates the elements that the Legislature identified as important for Delta management. YCWA's water transfer revenues under the Yuba Accord support a robust science program that studies the Yuba River's fisheries and the Yuba Accord's effectiveness in improving conditions for those fisheries. This program is producing numerous scientific studies that are improving understanding of the Sacramento Valley's salmonid fisheries. YCWA has budgeted $6 million to support this science program for the period of 2009 through 2016. In addition, in operating its facilities under the Yuba Accord and pursuant to the Fisheries Agreement, YCWA consults with a River Management Team (RMT) that comprises representatives of CDFG, USFWS, NMFS, and NGOs. The RMT also provides a forum within which stakeholders can develop studies necessary to support YCWA's FERC relicensing.

2. IMPLEMENTING THE SWRCB DFC ON THE YUBA RIVER

As previously stated, aspects of the SWRCB DFC identified in the SWRCB Report that would potentially apply to the Yuba River include:

- 75 percent of unimpaired Delta outflow from January through June
- 75 percent of unimpaired Sacramento River inflow from November through June

The analysis of effects of implementing the SWRCB DFC on the Yuba River includes a number of assumptions that address how an additional downstream regulatory constraint would be applied to water right holders. The first set of assumptions pertains to interpreting how the SWRCB DFC would be applied to the lower Yuba River. For outflow from the lower Yuba River, the timeframe included in the criterion of *"75 percent of unimpaired Delta outflow from January through June"* is encompassed by the criterion of *"75 percent of unimpaired Sacramento River inflow from November through June."* For this analysis, it is assumed that when the SWRCB Report refers to *"Sacramento River inflow,"* the intention is Sacramento River inflow to the Delta. Further, it is assumed that unimpaired Sacramento River inflow to the Delta is directly related to unimpaired Delta outflow, which allows for interpretive application of the SWRCB DFC to lower Yuba River outflows. If the SWRCB DFC, as presented in the SWRCB Report, were implemented, this analysis assumes that outflow from the lower Yuba River would need to conform to the same 75 percent of unimpaired flow during November through June.

Additional assumptions pertain to Yuba River watershed operations. From a water operations standpoint, the Yuba River watershed is split into upper and lower sets of systems. In the upper watershed: (1) the South Feather Water and Power Agency diverts water from Slate Creek, a tributary to the North Yuba River to the South Fork Feather River; (2) Nevada Irrigation District has storage facilities within the Middle and South Yuba River watersheds and diverts water from the Middle and South Yuba River to the Bear River watershed; and (3) Pacific Gas and Electric Company (PG&E) has storage and diversion facilities on the South Yuba River and diverts water from this watershed to the Bear and North Fork of the American River watersheds. In the lower Yuba River, YCWA is responsible for meeting lower Yuba River instream flow requirements and demands, and Browns Valley Irrigation District diverts water at the Pumpline Diversion Facility, located 1 mile upstream from Daguerre Point Dam.

For this analysis, a general assumption was made that the upper watershed projects would comply with a requirement to release or bypass 75 percent of the unimpaired flow at each storage and diversion facility. This assumption was made for two reasons: (1) modeling implementation of the SWRCB DFC for each of the numerous individual upstream systems would be very difficult and complicated due to the network of diversion and conveyance systems; and (2) it would result in the "best case scenario" for meeting this requirement from the upstream systems and focuses the effects of operation for the criteria on the YRDP on the lower Yuba River. In other words, this assumption may result in overestimation of the amount of flow in the Yuba River that would be available to implement the SWRCB DFC. In reality, the upper watershed projects have nowhere near the capacities to release 75 percent of the inflow until they are spilling over the top of or around the various dams. Even New Bullards Bar Reservoir, the primary release from which is New Colgate Powerhouse, with the largest pelton wheels in the western hemisphere, only has a release capacity of 3,430 cubic feet per second (cfs) at maximum pool. The inflow to New Bullards Bar Reservoir exceeds this amount 11 percent of the time during November through June.

2.1 MODELING BASELINE AND DELTA FLOW CRITERIA SCENARIOS

This section provides an overview of the modeling of the Yuba River system. The intent of the modeling is to provide comparative results between: (1) the Baseline Condition, where the YRDP is operated under current conditions to meet project objectives and regulatory requirements, including the Yuba Accord; and (2) a condition where the SWRCB DFC is superimposed as an additional regulatory requirement.

To simulate the effects of the SWRCB DFC on the YRDP, a daily model, under development to support YCWA's ongoing FERC relicensing, was modified to include the SWRCB DFC. This model includes operations of New Bullards Bar Dam and Reservoir, other aspects of the YRDP, the U.S. Army Corps of Engineers' (USACE) Englebright Reservoir, and PG&E's Narrows 1 Powerplant. The daily model includes considerations for flood management operations, minimum flow requirements, storage management, hydropower generation, recreation, and agricultural water supply, as well as all of the major requirements of the existing FERC license terms for the YRDP. Modeling of the SWRCB DFC scenario used existing infrastructure and operational requirements, with the addition of a superimposed minimum instream flow requirement for Yuba River outflow corresponding to 75 percent of the unimpaired flow from the Yuba River Basin during the November through June period.

To characterize the upper Yuba River watershed inflow to the lower watershed, an unimpaired hydrology time series provided by the Yuba-Bear/Drum-Spaulding Projects' relicensing was modified for the SWRCB DFC scenario so that 75 percent of the daily unimpaired flow was flowing to the lower Yuba River. Because the upper watershed was not explicitly modeled for the SWRCB DFC, the assumptions used in the analysis include some error in the estimation of inflow. First, as previously stated, the upper watershed facilities cannot release 75 percent of the unimpaired inflow during many times in the November through June period. Second, during July through October, historical flow to the lower Yuba River is used; since the SWRCB DFC requires such high releases when reservoirs are typically storing water, it is unlikely that the upstream projects would have enough stored water to make releases at historical levels. Therefore, the flow to the lower Yuba River during July through October is likely overestimated, and the impacts of the SWRCB DFC on beneficial uses of water in the lower Yuba River would likely be even higher than those shown in this analysis.

The daily model, developed based upon historical hydrology, simulates flows for the period extending from water years 1976 to 2004. This simulation period includes the 1977 drought year-of-record, the 6-year drought period of 1987 to 1992, 2 years (1982 and 1983) characterized by extremely high flows, and 5 wet years in succession from 1995 to 1999. Thus, the 29-year time period of simulation captures many of the hydrologic extremes in the Yuba River watershed, and well represents the spectrum of hydrology, under both the Baseline Condition and the SWRCB DFC scenario.

3. CHANGES DUE TO THE SWRCB DELTA FLOW CRITERIA

The Yuba Accord development process used a full allocation of available water across a wide spectrum of hydrology for the various beneficial uses of water in the watershed, including local irrigation deliveries and instream flows for fish. Full allocation means that, for a given runoff volume, particularly under drier conditions, all of the runoff is allocated to instream flows; local deliveries; and carryover storage which is used to ensure the following-year flow requirements and some agricultural deliveries could be met in case the following year was very dry. Also, as a result of operating to carryover storage targets, the coldwater pool in New Bullards Bar Reservoir is preserved and available for the benefit of aquatic resources in the lower Yuba River. In addition to the current year's runoff volume, water stored in New Bullards Bar Reservoir during previous years is used to augment natural flow volumes in the drier years. The Yuba Accord includes a conjunctive use program that improves water supply reliability and provides a direct instream flow benefit during the driest years by having local farmers irrigate with groundwater, allowing a portion of their surface water deliveries to remain in the lower Yuba River to increase flows and water temperatures.

This analysis demonstrates the direct effects that would occur from implementation of the SWRCB DFC on the multiple benefits provided by the Yuba Accord to lower Yuba River water-related resources, including the following:

- New Bullards Bar Reservoir storage
- Lower Yuba River flows
- Lower Yuba River water temperatures
- Yuba County Water Agency irrigation deliveries
- Colgate Powerhouse generation
- Delta Inflow contribution

3.1 NEW BULLARDS BAR RESERVOIR STORAGE AND LOWER YUBA RIVER MINIMUM FLOW REQUIREMENTS

The amount of water in storage in New Bullards Bar Reservoir at the end of September (end-of-September storage) is an important impact evaluation indicator: it is used in the calculation of the North Yuba Index to determine the next year's minimum instream flow requirements for the Yuba Accord, and it is used in planning irrigation deliveries and imposing shortages to these deliveries.

3.1.1 New Bullards Bar Reservoir Storage Impacts

New Bullards Bar Reservoir end-of-September storage was examined through the evaluation of exceedance curves under implementation of the SWRCB DFC, relative to the Baseline Condition. New Bullards Bar Reservoir end-of-September storage exceedance curves were developed for the 1976 through 2004 simulation period. These storage exceedance curves represent the probability, as a percentage of years that simulated storage volume would be met or exceeded, under the Baseline Condition and with the implementation of the SWRCB DFC (**Figure 3.1-1**).

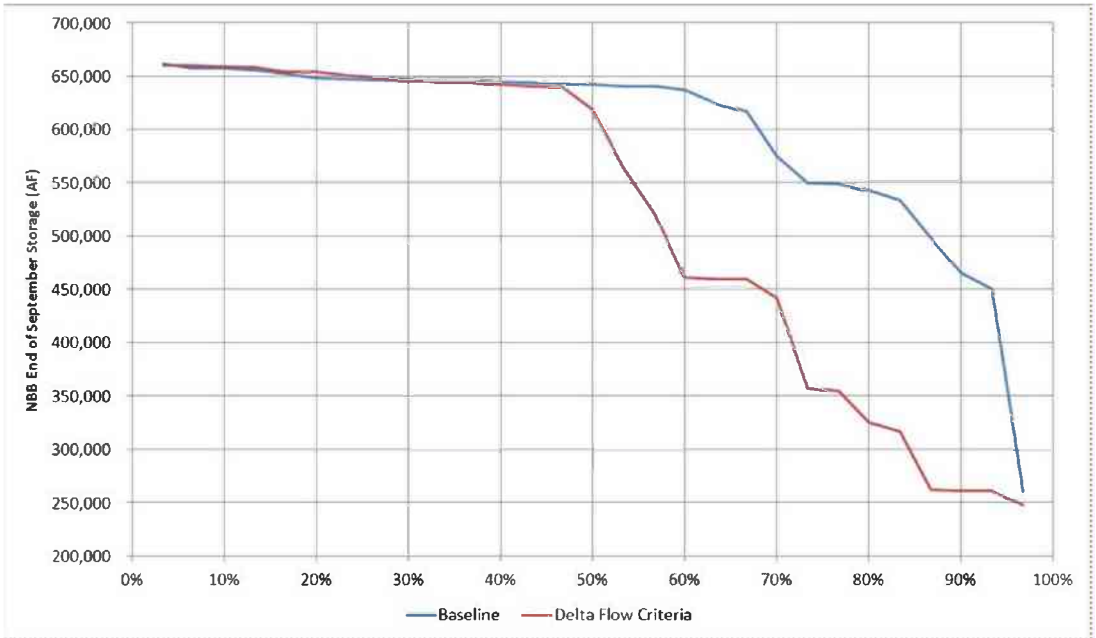

Figure 3.1-1. Exceedance Probability of New Bullards Bar Reservoir End-of-September Storage under the SWRCB DFC Scenario Compared to the Baseline Condition

The desired end-of-September storage in New Bullards Bar Reservoir, 650,000 acre-feet, is reached or closely approached about 65 percent of years under the Baseline Condition, but would be reached in about 47 percent of the years with implementation of SWRCB DFC. When end-of-September storage is simulated to be below 460,000 acre-feet, shortages in irrigation deliveries are imposed to maintain sufficient storage for following-year drought protection. As shown in Figure 3.1-1, end-of-September storage is at or below 460,000 acre-feet approximately 8 percent of the time under the Baseline Condition, but about 40 percent of the time under the SWRCB DFC scenario. Moreover, New Bullards Bar Reservoir would be drained of all usable storage, down to 234,000 acre-feet, by the end of September more than 12 percent of the time, or more than once every 8 years, under the SWRCB DFC scenario.

In addition to end-of-September storage, the SWRCB DFC scenario results in reductions in the amount of water stored in New Bullards Bar Reservoir throughout the year over the 29-year simulation period.

Figure 3.1-2 shows New Bullards Bar Reservoir storage under the Baseline Condition and the SWRCB DFC scenario for the model simulation period extending from water year 1976 to 2004. New Bullards Bar Reservoir has a normal maximum capacity of 966,103 acre-feet and a FERC-required minimum pool of 234,000 acre-feet, resulting in 732,103 acre-feet of active storage. As shown on Figure 3.1-2, New Bullards Bar Reservoir is drawn down to minimum pool on five occasions under the SWRCB DFC scenario, and nearly to minimum pool on a sixth year. During these occasions, there would no longer be any ability to augment runoff, which is at its lowest during these dry conditions, with releases from New Bullards Bar Reservoir storage.

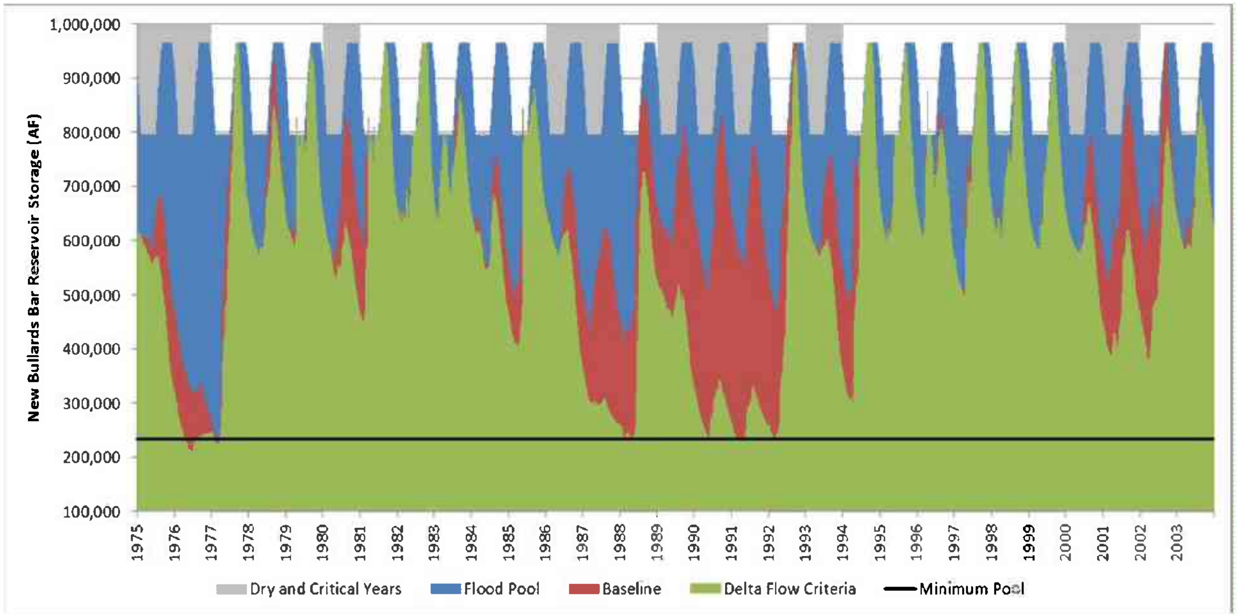

Figure 3.1-2. Simulated Daily New Bullards Bar Reservoir Storage under the SWRCB DFC Scenario Compared to the Baseline Condition

In Figure 3.1-2, the top of the green shading indicates the simulated New Bullards Bar Reservoir storage levels under the SWRCB DFC scenario, the top of the red shading indicates the simulated New Bullards Bar Reservoir storage levels under the Baseline Condition, and the top of the blue shading indicates the maximum authorized New Bullards Bar Reservoir storage amounts under the applicable flood control criteria.

3.1.2 Lower Yuba River Minimum Instream Flow Requirement Impacts

Reductions in New Bullards Bar Reservoir end-of-September storage have the potential to result in reductions in the following year's minimum instream flow requirements. In developing the Yuba Accord, six flow schedules plus a Conference Year were formulated, fully allocating available water through the full range of hydrology. The Conference Year provisions include the absolute minimum flows for this year type along with limitations on irrigation deliveries and other mechanisms that could provide additional flow to the lower Yuba River. **Figure 3.1-3** depicts the resulting Yuba Accord flow schedules for each year of the simulation of the Baseline Condition and SWRCB DFC scenario. Schedule 1 has the highest flow requirements and Schedule 7, which represents a Conference Year, has the lowest flow requirements.

As shown in Figure 3.1-3, the SWRCB DFC would shift the occurrence of flow schedules, with a higher frequency of occurrence of flow schedules with lower instream flow requirements relative to the Baseline Condition. With implementation of the SWRCB DFC there would be 7 years in the 29-year simulation (or about a 24 percent occurrence) of lower required minimum flows in the lower Yuba River. In one of those years (1992), the schedule would change from a Schedule 5 to a Conference Year condition. As a comparison, the annual flow volume for the Marysville Gage in the lower Yuba River under Schedule 5 year is 334,818 acre-feet, whereas the annual required flow volume for a Conference Year is 173,722 acre-feet, or about half of the Schedule 5 volume.

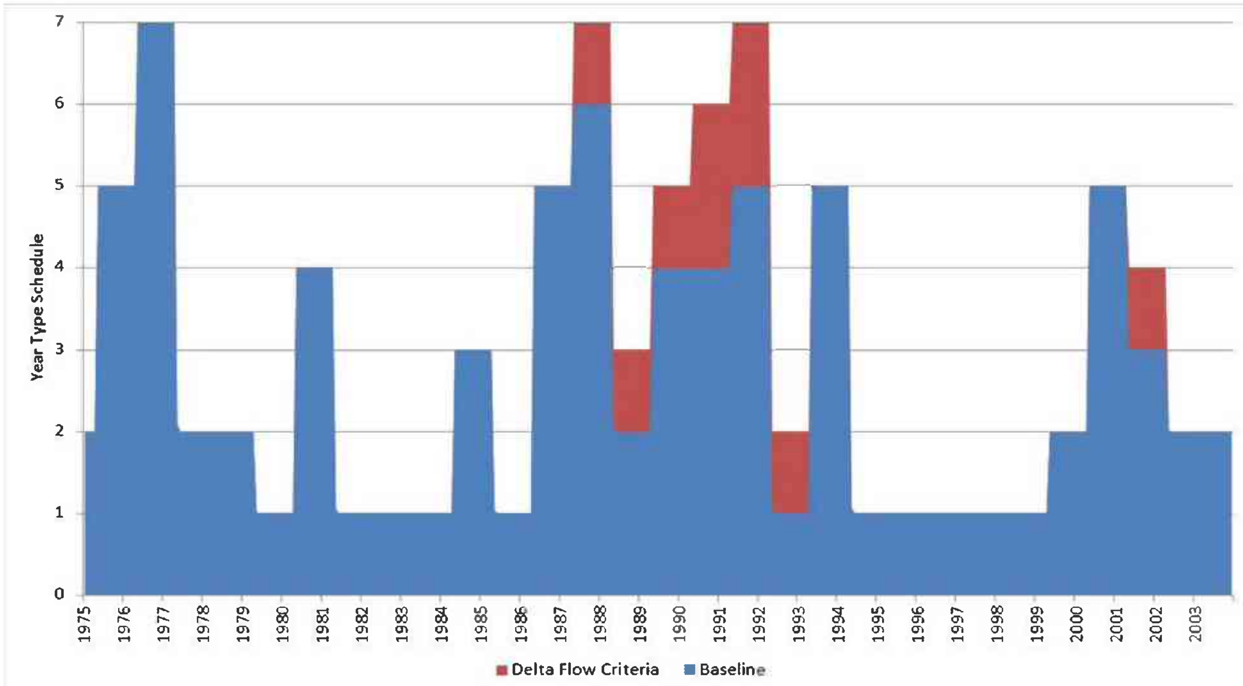

Figure 3.1-3. Simulated Yuba Accord Flow Schedules Under the Baseline Condition and the SWRCB DFC Scenario

3.2 LOWER YUBA RIVER FLOWS

Comparative differences in lower Yuba River flows are examined through the evaluation of exceedance curves under implementation of the SWRCB DFC relative to the Baseline Condition. Appendix C includes flow exceedance plots over the 29-year period of evaluation, by month, at two locations: the Smartsville Gage, located below Englebright Dam which is representative of the upper section of the lower Yuba River, and the Marysville Gage, located 5.6 miles upstream from the mouth of the lower Yuba River and which is representative of the lower section of the lower Yuba River.

3.2.1 Winter Precipitation Season

The winter precipitation season in the Yuba River watershed extends from December through March. During these months, storms produce low elevation rains and upper elevation snow that result in rapid increases and decreases in runoff flows as storms pass over the watershed. In general, flows in the lower Yuba River are relatively similar under the Baseline Condition and SWRCB DFC scenario during the winter. Flows in the lower Yuba River are strongly associated with storm flows; most of the runoff is passed through the upper watershed reservoirs and through New Bullards Bar and Englebright reservoirs, up to the capacities of the outlet works, or as required by flood control rule curves. Under non-storm conditions during winter, storage in New Bullards Bar Reservoir is held relatively constant with little or no diversion to storage, little to no downstream irrigation deliveries, and minimal releases for downstream diversions for waterfowl habitat. Implementation of the SWRCB DFC generally would not influence releases during the winter, because on average, more than 75 percent of the watershed runoff already is bypassed or released under the Baseline Condition.

Figure 3.2-1 shows an exceedance probability plot of daily flow for the two scenarios at the Marysville Gage for the month of February. As shown in the figure, the exceedance probabilities of flow are almost identical for the two scenarios over the full range of exceedance. As shown in Appendix C, for the months of December through March, the SWRCB DFC scenario has somewhat higher flows at the same exceedance probability as the Baseline Condition in the 5 percent to 75 percent exceedance range for December, slightly higher flows in the 15 percent to 85 percent range for January, no significant difference in February, and higher flows in the 30 percent to 95 percent exceedance range for March. The March flows for the 30 to 95 percent exceedance range under the SWRCB DFC scenario are higher than the corresponding flows under the Baseline Condition because there are higher diversions to New Bullards Bar Reservoir storage under the Baseline Condition during times of early snowmelt whenever the reservoir is well below the flood reservation pool. Under the SWRCB DFC scenario, the corresponding diversions to storage under these conditions are lower and more water is released to meet the 75% of unimpaired flow requirement.

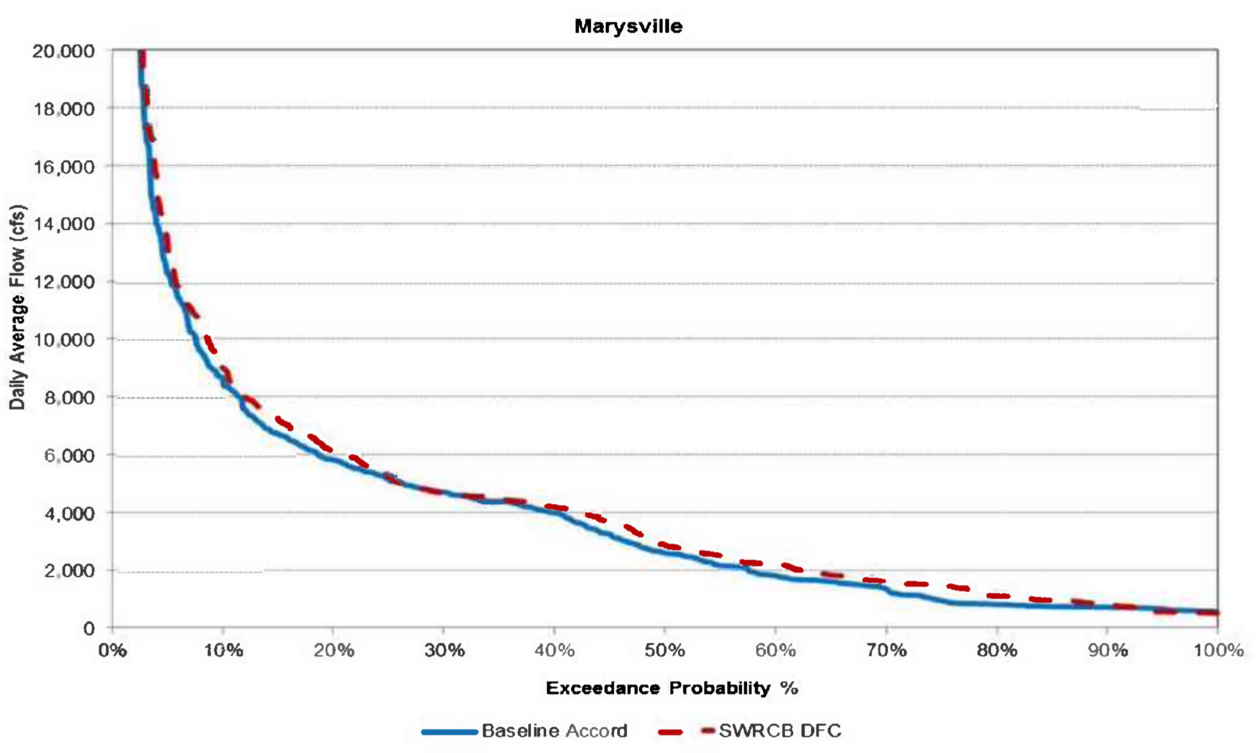

Figure 3.2-1. Exceedance Probability of Simulated Mean Daily Flow in February at the Marysville Gage under the SWRCB DFC Scenario Compared to the Baseline Condition

3.2.2 Spring Snowmelt Runoff Season

The spring snowmelt runoff season extends from April through June. This season is characterized by less precipitation than during the winter season and by steady, prolonged flows from snowmelt runoff during wetter years, and during a more limited period of April and early May in drier years. During May and June, downstream irrigation deliveries are supplied by either releases from New Bullards Bar Reservoir storage or direct diversion of runoff, or a combination of both. Implementation of the SWRCB DFC would result in substantially higher flows in the lower Yuba River during this time; diversions to the Bear and American river watersheds from the upper Yuba River watershed facilities would be severely curtailed, and diversions to storage into New Bullards Bar Reservoir that occurs under the Baseline Condition would be severely restricted under the SWRCB DFC scenario.

For the spring snowmelt runoff months of April and May, the SWRCB DFC scenario has much higher flows in the lower Yuba River relative to the Baseline Condition. For example, a comparison of the exceedance probabilities of simulated daily flows during April at the Marysville Gage for the SWRCB DFC scenario and the Baseline Condition is presented in **Figure 3.2-2**. The exceedance probability plot for May is similar to the plot for April.

During April and May, implementation of the SWRCB DFC would result in flows at the Marysville Gage that would be two to three times higher than those under the Baseline Condition nearly three quarters of the time. These dramatically higher flows are associated with reduced diversions to the Bear and American River watersheds and diversion of runoff into New Bullard Bar Reservoir storage. Reductions in storage would lead to lower flows in the lower Yuba River during other months of the year, shortages in irrigation deliveries, or both, as described later in this report.

In contrast to April and May, simulated mean daily flows in the lower Yuba River during June would be slightly higher over most of the range of the exceedance probabilities under the SWRCB DFC scenario, relative to the Baseline Condition. However, flows at the Smartsville Gage would be lower during periods of low flow conditions under the SWRCB DFC scenario relative to the Baseline Condition and equal or slightly lower at the Marysville Gage under the SWRCB DFC scenario. Implementation of the SWRCB DFC would result in lower flows at the Marysville Gage during June in drier years; during these times, releases are made from New Bullards Bar Reservoir storage to augment natural flows under the Baseline Condition pursuant to the Yuba Accord, resulting in flows that are higher than 75 percent of the unimpaired flow, as required by the SWRCB DFC scenario.

3.2.3 Summer Dry Season

The summer dry season includes July and August. During these months, releases from New Bullards Bar Reservoir storage provide the majority of flow to the lower Yuba River in all but the wettest years. Even during wet years, storage releases contribute significantly to flows in the lower Yuba River.

During July and August, the SWRCB DFC do not apply (they apply only from November through June). However, differences in lower Yuba River flows would occur between the two scenarios due to the SWRCB DFC reductions in New Bullards Bar Reservoir storage during the spring snowmelt runoff season of the current year or that would be carried over from previous years.

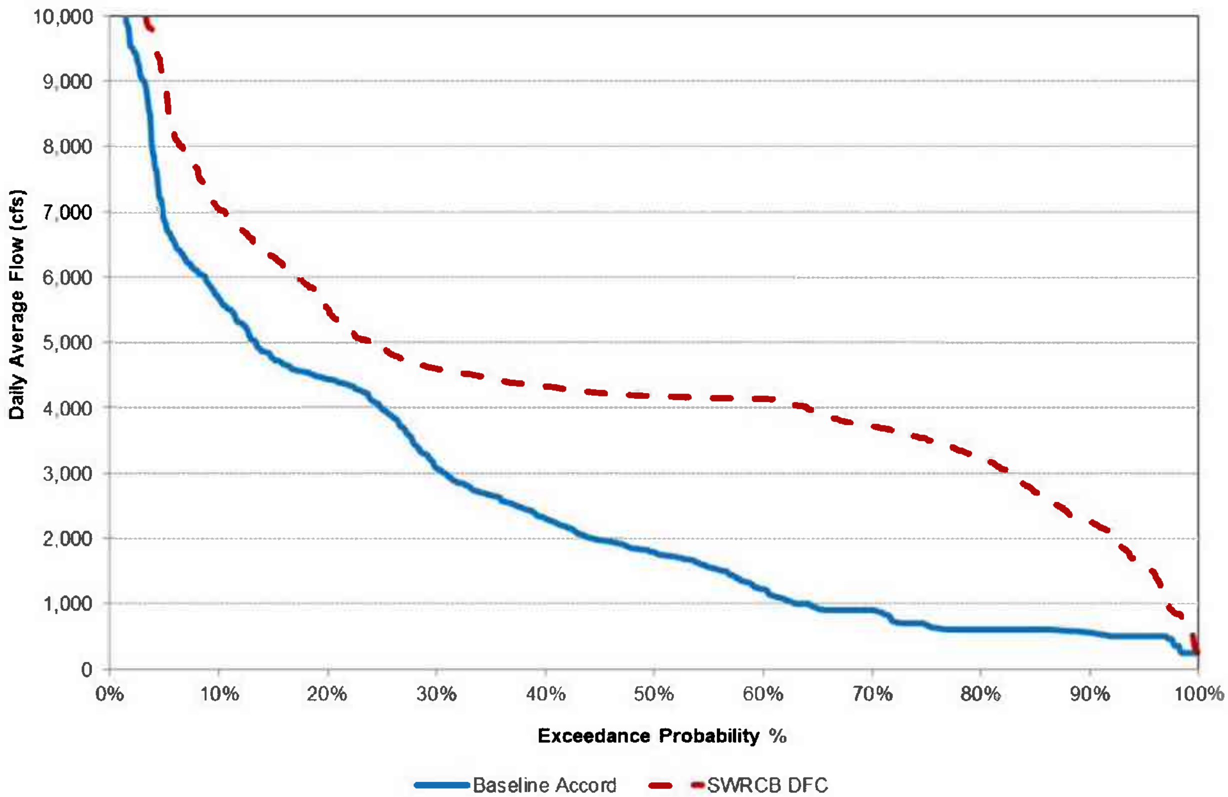

Figure 3.2-2. Exceedance Probability of Simulated Mean Daily Flow in April at the Marysville Gage under the SWRCB DFC Scenario Compared to the Baseline Condition

Exceedance probability distributions during the month of July comparing the SWRCB DFC scenario with the Baseline Condition are presented for the Smartsville Gage on **Figure 3.2-3** and for the Marysville Gage on **Figure 3.2-4**. The flow exceedance probabilities during August are similar to those for July. The figures show that for relatively wet conditions the SWRCB DFC scenario has higher flows than the Baseline Condition. This is an artifact of the model: the model attempts to avoid spills from Englebright Reservoir resulting from releases from the upper watershed to meet the SWRCB DFC in May and June. The water not released in late May and June is subsequently released in July. In actual application under the SWRCB DFC, the releases would be made in late May and June to comply with the SWRCB DFC, and higher July flows would not occur. Under actual conditions, the flows at this exceedance range are expected to be similar for the two scenarios.

Over most of the range of the exceedance probabilities, the two scenarios have generally similar flows. In the driest conditions, implementation of the SWRCB DFC would result in substantially lower flows at the Smartsville Gage, relative to the Baseline Condition. These lower flows at the Smartsville Gage under the SWRCB DFC scenario primarily result from reduced releases from New Bullards Bar Reservoir storage due to irrigation delivery shortages. Irrigation delivery shortages would be imposed due to relatively low storage in New Bullards Bar Reservoir; the end-of-September carryover storage target could not be met without imposing shortages.

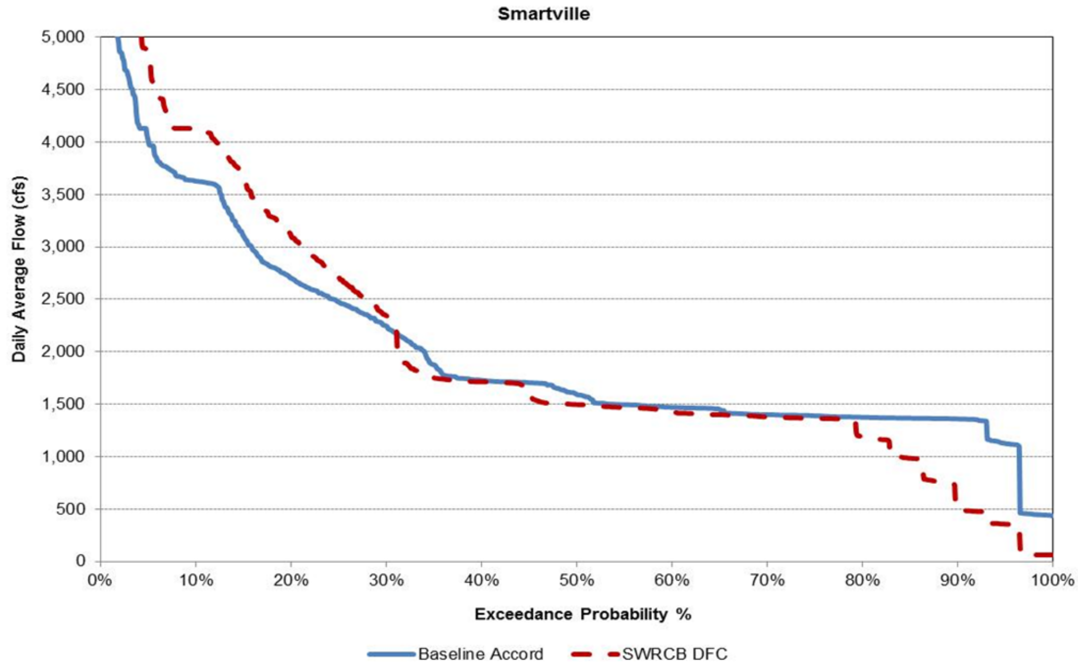

Figure 3.2-3. Exceedance Probability of Simulated Mean Daily Flow in July at the Smartsville Gage under the SWRCB DFC Scenario Compared to the Baseline Condition

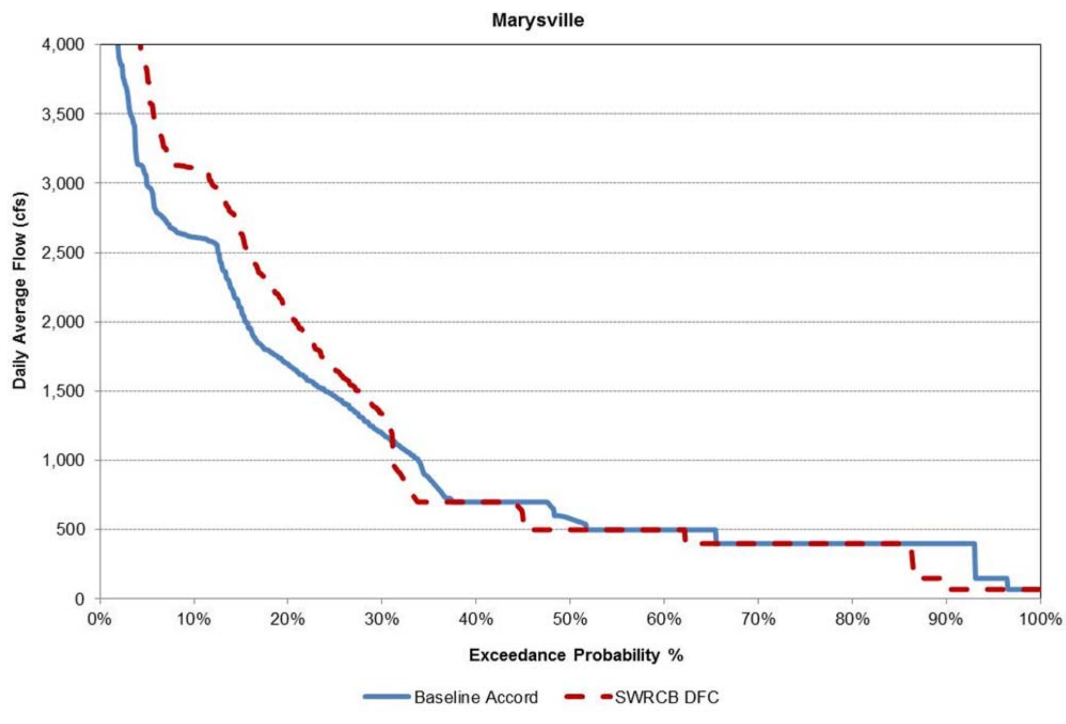

Figure 3.2-4. Exceedance Probability of Simulated Mean Daily Flow in July at the Marysville Gage under the SWRCB DFC Scenario Compared to the Baseline Condition

At the Marysville Gage, the 90 percent exceedance flow is 70 cfs for the SWRCB DFC scenario, which corresponds to the Yuba Accord Conference Year minimum flow requirement. Under the Baseline Condition, a flow of 70 cfs would be expected to occur during the summer only once in 100 years and only in 1977, which represents a 1-in-200 year drought. In contrast, under the SWRCB DFC scenario, Conference Years occur three times – in 1977, 1988 and 1992. The North Yuba Index is also very close to triggering a Conference Year in a fourth year, 1991. The additional Conference Years have unimpaired runoff volumes corresponding to a 1-in-10 year drought, but, due to the substantial reduction in New Bullards Bar Reservoir storage under the SWRCB DFC scenario, the probability of occurrence of a Conference Year is substantially increased.

The flow corresponding to the 92 percent to 96 percent exceedance probability for the Baseline Condition, shown in Figure 3.2-4, is 150 cfs, and does not include the additional flow of about 240 cfs that would occur under the Yuba Accord. This additional flow would result from the 30,000 acre-feet of water that is foregone irrigation delivery in Schedule 6 years. The resulting correct flow for this exceedance range is therefore about 390 cfs.

3.2.4 Fall Flow Stability Season

The fall flow stability season extends from September through November, and is characterized by operations to maintain stable flow rates during the spring-run and fall-run Chinook salmon spawning periods. Commencing on about September 1, YCWA operations typically strive to achieve a target flow of between 700 cfs and 900 cfs at the Smartsville Gage, depending on the minimum flow requirements determined from the North Yuba Index. Although some releases are made for flooding of waterfowl habitat and rice decomposition, agricultural irrigation deliveries at Daguerre Point Dam are much lower during fall than summer, resulting in similar flow rates in the lower Yuba River both above and below Daguerre Point Dam.

During September, simulated lower Yuba River flows would always be lower under the SWRCB DFC scenario than under the Baseline Condition, and flows are substantially lower in the driest years. The 90 percent exceedance flow for the SWRCB DFC is 179 cfs at the Smartsville Gage and 70 cfs at the Marysville Gage. In extreme contrast, flows under the Baseline Condition at the 90 percent exceedance level are 616 cfs at the Smartsville Gage and 400 cfs at the Marysville Gage. **Figure 3.2-5** shows the exceedance probability of simulated flows at the Smartsville Gage during September for the SWRCB DFC scenario and the Baseline Condition.

For relatively dry conditions in October, flows at the Smartsville Gage are lower under the SWRCB DFC scenario relative to the Baseline Condition, due to lower releases from New Bullards Bar Reservoir for irrigation diversions because of shortages. At the Marysville Gage, the flow exceedance probability distributions are similar under the SWRCB DFC scenario and the Baseline Condition.

During November, a month in which SWRCB DFC are imposed, flows are higher under the SWRCB DFC scenario than under the Baseline Condition in wetter conditions at the Marysville Gage. Otherwise, the SWRCB DFC scenario results in lower flows than under the Baseline Condition. Therefore, contrary to the intent of the SWRCB DFC, implementation of the SWRCB DFC scenario would result in lower outflow from the Yuba River during November 65 percent of the time.

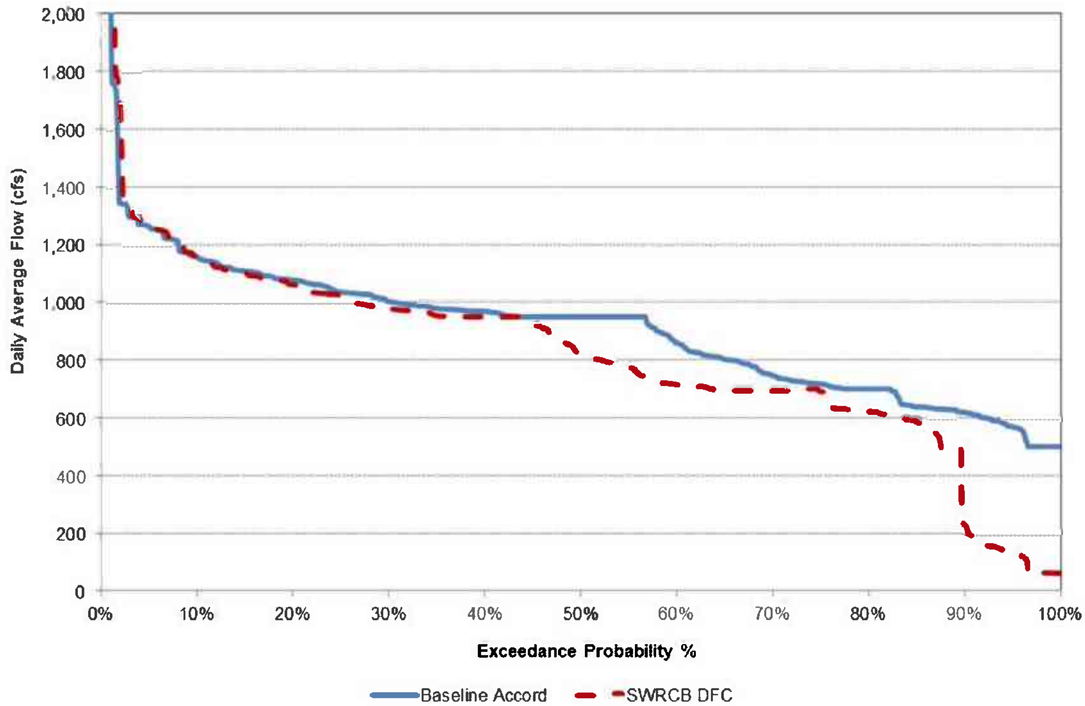

Figure 3.2.5. Exceedance Probability of Simulated Mean Daily Flow in September at the Smartsville Gage under the SWRCB DFC Scenario Compared to the Baseline Condition

3.2.5 Dry Year Flows

In relatively dry years, implementation of the SWRCB DFC scenario would result in increased flow in the lower Yuba River, relative to the Baseline Condition, for only the limited number of days during storms or when snowmelt runoff occurs in the spring. These increased flows would result in lower New Bullards Bar storage for portions of every year, and dramatically lower storage continuously in dry and critically dry years.

Implementation of the SWRCB DFC scenario would create Conference Years through the depletion of New Bullards Bar Reservoir storage in two years (1988 and 1992) out of the 29-year simulation period. Water year 1977 is also a Conference Year, but this is due to 1-in-200 year drought runoff conditions. A comparison of simulated daily average flows during 1992 for the SWRCB DFC scenario and the Baseline Condition are presented for the Smartsville Gage in **Figure 3.2-6** and for the Marysville Gage in **Figure 3.2-7**. These figures demonstrate that increased flows due to implementation of the SWRCB DFC scenario occur in March, April, and May. The Baseline Condition exhibits generally higher flows from November 1991 through early February 1992, even though the SWRCB DFC requirements would apply during these months.

Implementation of the SWRCB DFC scenario in dry years would result in substantially lower flows during July through September. Under the Baseline Condition, dry year flows typically exceed 1,000 cfs during July and August and range from about 550 to 750 cfs at the Smartsville Gage in September, and are consistently about 450 cfs at the Marysville Gage. In contrast, flows under the SWRCB DFC scenario during these months range from about 140 cfs to 400 cfs at the Smartsville Gage, and are consistently about 70 cfs at the Marysville Gage. The lower Yuba

River has only experienced flows this low once over the past 40 years – in 1977, a 1-in-200 occurrence drought year. The extremely low summer flows at the Smartsville Gage under the SWRCB DFC scenario are primarily due to lower releases from New Bullards Bar Reservoir, resulting from a 90 percent reduction in irrigation deliveries from Daguerre Point Dam. Summer flows during the other two Conference Years, 1977, due to drought conditions, and 1988, created by the SWRCB DFC scenario, are similar to the 1992 flows for the SWRCB DFC scenario. Flows under the Baseline Condition during 1977 average about 470 cfs at the Smartsville Gage and consistently are about 70 cfs at the Marysville Gage, and average about 600 cfs to 1,200 cfs at the Smartsville Gage and 150 cfs to 350 cfs at the Marysville Gage during 1988.

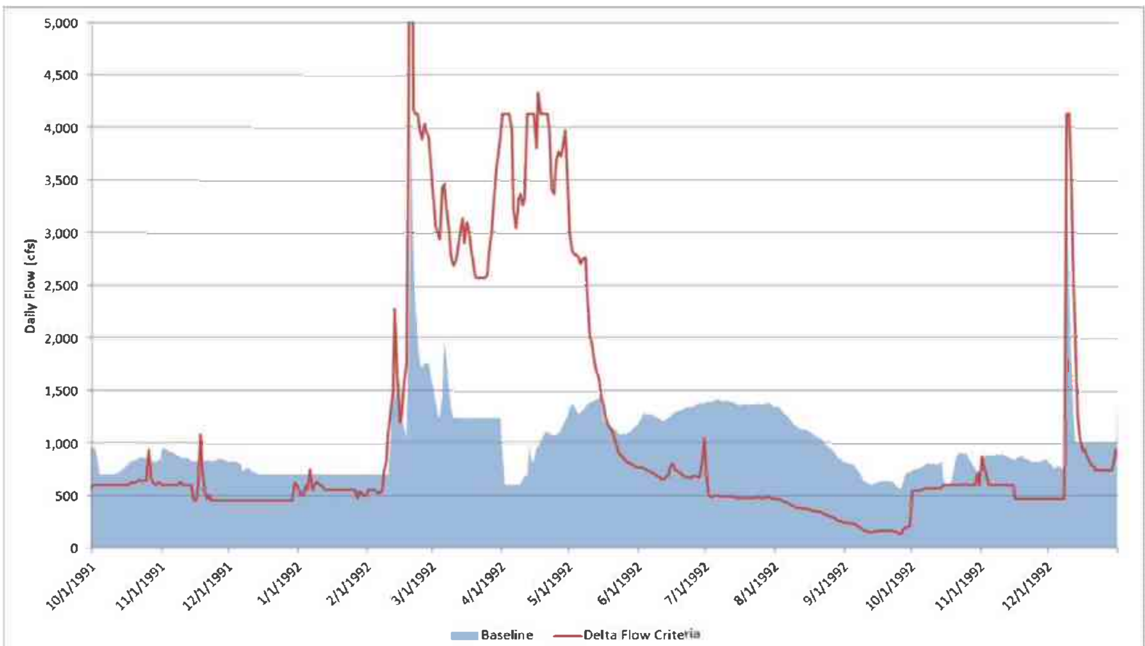

Figure 3.2-6. Simulated Average Daily Flows at the Smartsville Gage for the Period Extending from October 1991 to December 1992 under the SWRCB DFC Scenario Compared to the Baseline Condition

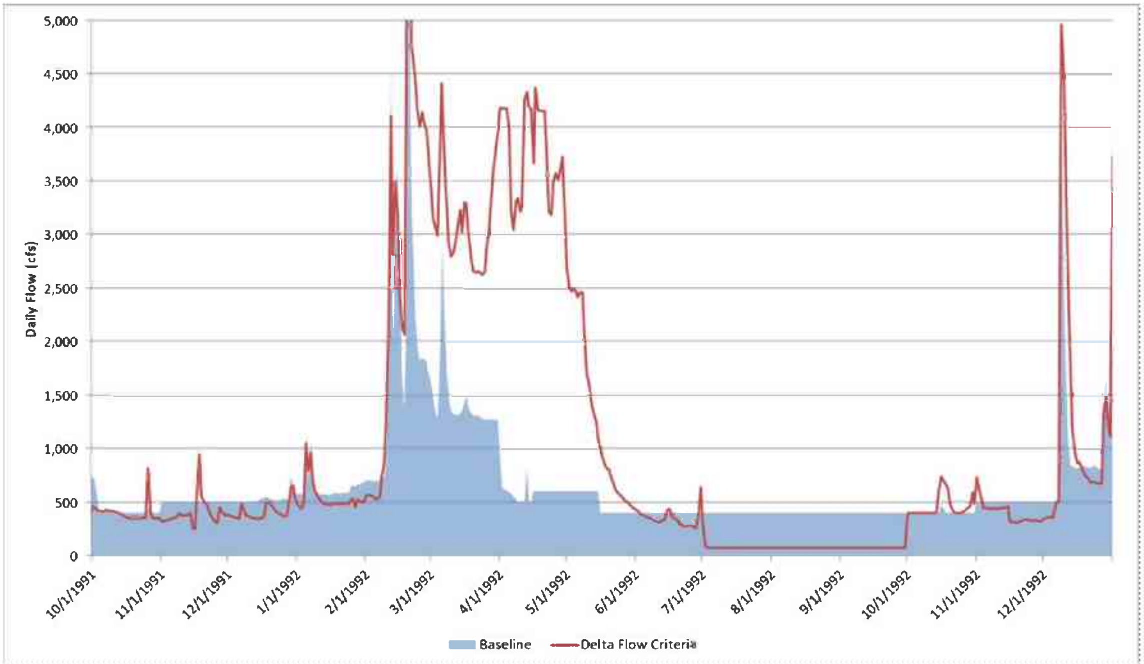

Figure 3.2-7. Simulated Average Daily Flows at the Marysville Gage for the Period Extending from October 1991 to December 1992 under the SWRCB DFC Scenario Compared to the Baseline Condition

3.3 WATER TEMPERATURES

Water temperatures in the lower Yuba River downstream of Englebright Dam are influenced by: (1) the temperature of the water released from New Bullards Bar Reservoir; (2) releases from Englebright Reservoir to the lower Yuba River; (3) operations under the Yuba Accord Fisheries Agreement, including magnitude, frequency, and duration of water releases; (4) natural mechanisms of heat transfer associated with characteristics of the physical environment such as river geometry; and (5) meteorological conditions.

Since water temperatures of the lower Yuba River are heavily influenced by coldwater pool releases from New Bullards Bar Reservoir in the summer and early fall, an analysis was prepared to simulate changes in release temperatures due to the fluctuation in flow rates and storage levels in the reservoir due to the SWRCB DFC. The analysis consisted of synthesizing an average New Bullards Bar Reservoir water temperature profile for each day of a year representing, 20 years of historical New Bullards Bar Reservoir temperature profiles, and correlating historical release temperature with the temperature profile in proximity to the reservoir low level outlet. This analysis resulted in a characterization of the zone of withdrawal from the reservoir that could be used with the synthesized profiles to determine release temperatures from the simulated daily reservoir elevations.

Currently no daily temperature model of the lower Yuba River exists, and the monthly modeling used in previous investigations was determined to be too coarse for this work. Additionally, the SWRCB DFC result in dramatic changes to the lower Yuba River flow regime and storage conditions in New Bullards Bar Reservoir, so these older models have not been calibrated or verified under such extreme conditions. Therefore, this analysis does not include any modeling analysis of lower Yuba River water temperatures, and New Bullards Bar Reservoir release temperatures through the New Colgate Powerhouse, computed as described above, along with examination of historical temperatures at low flows are used to assess the potential effects of the SWRCB DFC on downstream water temperatures.

3.3.1 Colgate Powerhouse Release Water Temperatures

Implementation of the SWRCB DFC scenario would result in higher release temperatures from New Bullards Bar Reservoir through the Colgate Powerhouse, relative to the Baseline Condition, as shown in **Figure 3.3-1**. Increases of more than 2 degrees F in release temperatures from New Bullards Bar Reservoir through the Colgate Powerhouse occur during summer and fall in 8 of the 29 years evaluated, or in approximately 28 percent of years, relative to the Baseline Condition. In certain years, differences in Colgate Powerhouse release water temperatures between the SWRCB DFC scenario and the Baseline Condition would be extreme, as exhibited in the 1976-1977 and the 1988-1992 dry year periods, as shown in **Figure 3.3-2**. For example, in the summer and fall of 1988 and 1992, the increase in Colgate Powerhouse release temperatures would be as much as 14 and 12 degrees F, respectively. Under the Baseline Condition, the Colgate Powerhouse release temperature exceeds 52 degrees F on only one day in 1988 and 1992. In contrast, the SWRCB DFC scenario results in much higher daily average water temperatures, exceeding 60 degrees F for most of July and August during 1988, and exceeding 55 degrees F from mid-June through November during 1992 and sometimes exceeding 60 degrees F.

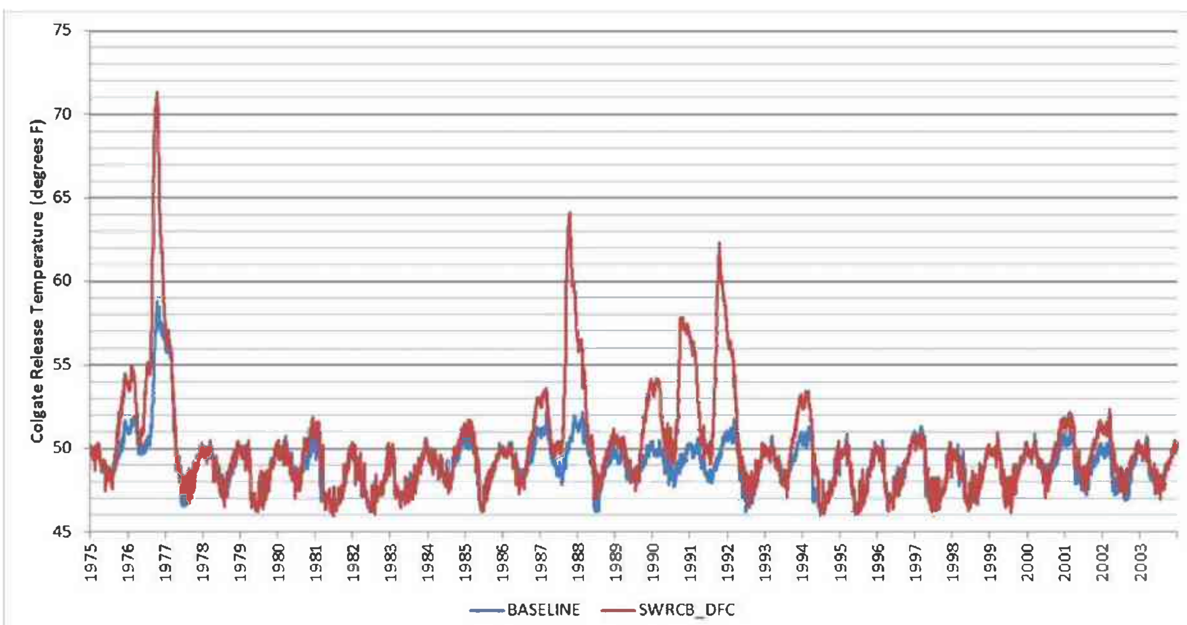

Figure 3.3-1. Simulated Average Daily Colgate Powerhouse Release Water Temperatures for the Period Extending from 1975 to 2004

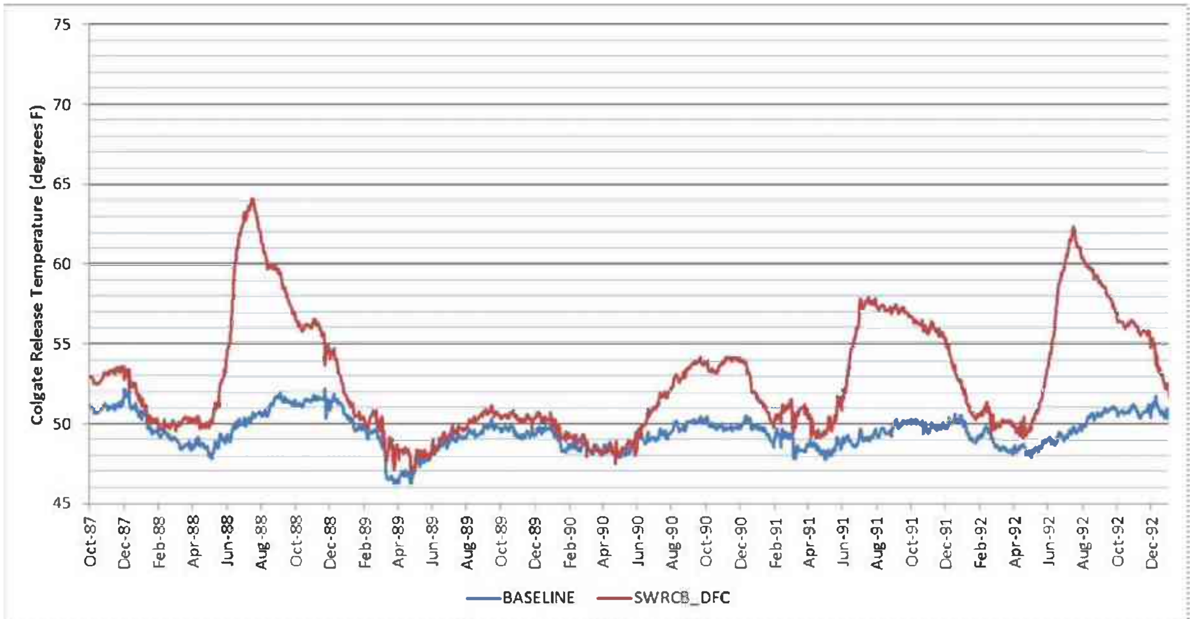

Figure 3.3-2. Simulated Average Daily Colgate Powerhouse Release Water Temperatures for the Period Extending from October 1987 through December 1992

3.3.2 Lower Yuba River Water Temperatures

Substantial heat transfer occurs in the lower Yuba River as a result of surface water-air interaction and solar radiant heating. With the exception of the Narrows Reach, the river channel is generally wide and flat with little or no bank shading from riparian vegetation, and substantial heat transfer at the water-air interface (YCWA et al. 2007). These high surface width-to-flow ratios also facilitate solar radiant heating. The amount of heat gain in the lower Yuba River is also influenced by flow rate. A longitudinal temperature gradient may be observed within the lower Yuba River.

Historical water temperatures provide an indication of the manner in which water temperatures increase as water flows downstream in the lower Yuba River. RMT (2010) reported that recent water temperature monitoring data in the lower Yuba River are available for 2006 to the present, during which time operations have complied with the Yuba Accord. **Figure 3.3-3** shows historical lower Yuba River water temperature and data illustrating seasonal and longitudinal trends in water temperature in the lower Yuba River**.** The lowest water temperatures are observed during January and February, and water temperatures steadily increase until mid-June or July, remain relatively high through September and steadily decrease thereafter. The coldest water temperatures are observed upstream at the Smartsville Gage, intermediate water temperatures occur at Daguerre Point Dam, and the warmest temperatures are observed downstream at the Marysville Gage for most months of the year. The least amount of spatial variation in water temperature is observed during late November through February, when water temperatures are similar at the three monitoring locations (RMT 2010).

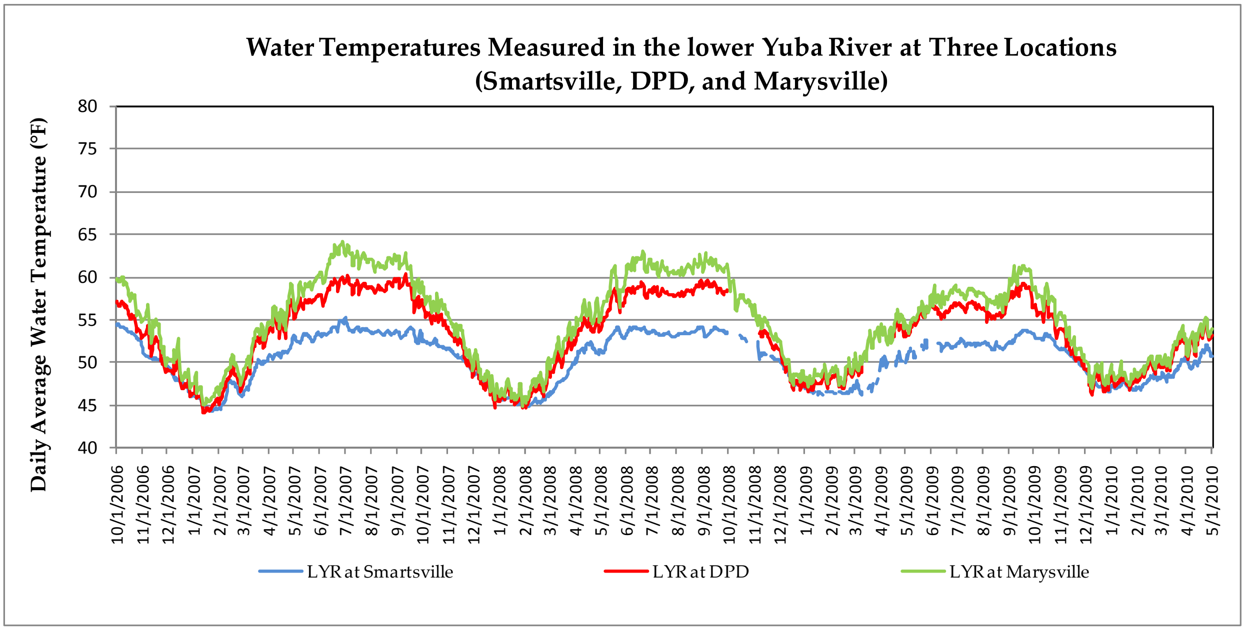

Figure 3.3-3. Water Temperatures Measured in the Lower Yuba River at Smartsville, Daguerre Point Dam, and Marysville Monitoring Locations for the period extending from October 2006 through April 2010 (from RMT 2010)

Relative to the Smartsville Gage, average daily water temperatures during the summers of 2007 through 2010 were approximately 5 degrees F warmer at Daguerre Point Dam and 8 degrees F warmer at the Marysville Gage. These water temperature monitoring data are for specific conditions occurring in late 2006 through 2010, pertain only to the lower Yuba River, and do not include an assessment of the amount of warming that would occur from Colgate Powerhouse releases and under reduced flows. Flows at Marysville Gage from late 2006 through 2010 were never lower than about 500 cfs, as stipulated by the Yuba Accord. Under the SWRCB DFC scenario, higher Colgate Powerhouse release water temperatures often coincide with the time periods when flows in the lower Yuba River are substantially lower, relative to the Baseline Condition.

One example of the magnitude of average daily temperature increases from the release of water at the Colgate Powerhouse through Englebright Reservoir, and then downstream at the Smartsville Gage, Daguerre Point Dam and Marysville Gage, and the longitudinal trend in warming associated with flow rates for June through October 2001 is shown in **Figure 3.3-4**. The flows during this time period were governed by SWRCB Revised Water Right Decision 1644 (SWRCB 2003), and reflect flows ranging from 275 to 300 cfs at the Marysville Gage during June, and then much higher flows, about 1,500 cfs, reflecting a water transfer, in July through August. As shown in Figure 3.3-4, at the lower flow rate during June, release water temperatures at the Colgate Powerhouse ranged from 48 to 50 degrees F, increased by 6 to 8 degrees F at Smartsville, increased another 5 degrees F at Daguerre Point Dam, and were up to as much as 15 degrees F above the Smartsville temperature at the Marysville Gage. The total increase in average daily water temperature from the Colgate Powerhouse release to the Marysville Gage at these lower flows during June ranged from 12 to 20 degrees F. When flows at the Marysville Gage were much higher during July and August, water temperatures increased 10 to 12 degrees F from the Colgate Powerhouse to the Marysville Gage.

In addition to historical water temperature monitoring data shown in Figure 3.3-4, previous water temperature studies on the Yuba River (YCWA 1998, 1992, 2007), demonstrate that release temperature and flow rate affect water temperatures in the lower Yuba River. Simulated Colgate Powerhouse release water temperatures and flows under the Baseline Condition and under the SWRCB DFC scenario during 1992 are shown compared to Smartsville Gage flows in **Figure 3.3-5** and compared to Marysville Gage flows in **Figure 3.3-6**. These figures show that during the hot summer months through September, flows under the SWRCB DFC scenario would be very low while concurrently warmer water would be released from New Bullards Bar Reservoir, relative to the Baseline Condition. Thus, implementation of the SWRCB DFC would result in higher Colgate Powerhouse release water temperatures, and lower flows during summer and early fall, which combined would result in higher water temperatures that would persist downstream in the lower Yuba River, relative to the Baseline Condition.

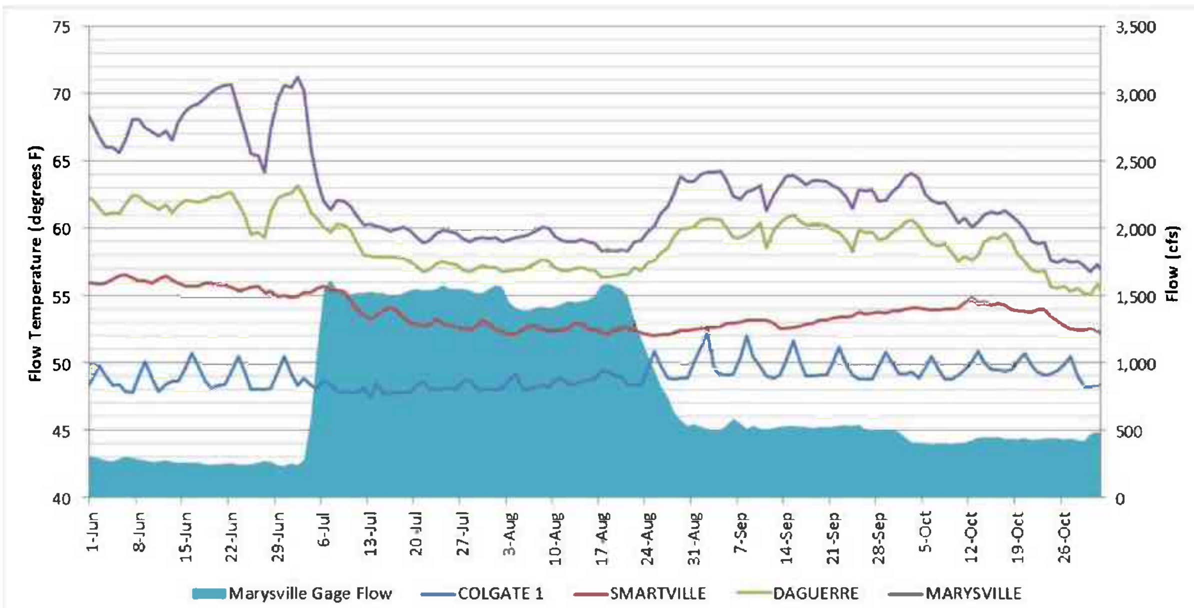

Figure 3.3-4. Water Temperatures Released from the Colgate Powerhouse and at the Smartsville Gage, Daguerre Point Dam and the Marysville Gage, and Flow at the Marysville Gage from June through October 2001

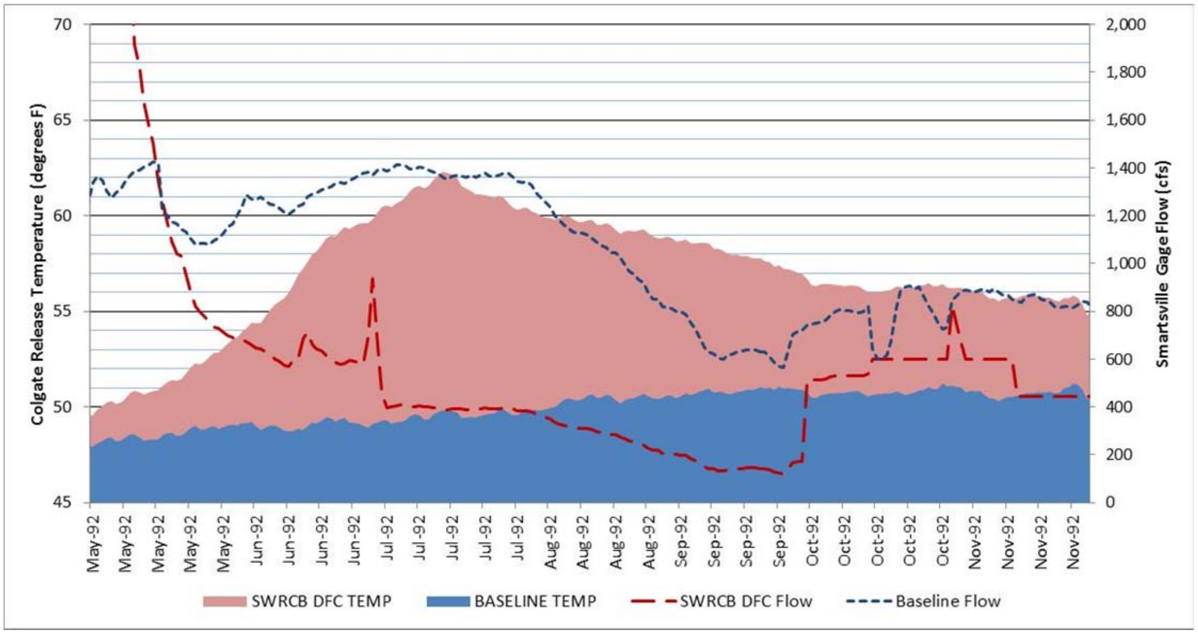

Figure 3.3-5. Simulated Colgate Powerhouse Release Water Temperature and Flow in the Lower Yuba River at the Smartsville Gage during 1992 under the SWRCB DFC Scenario Compared to the Baseline Condition

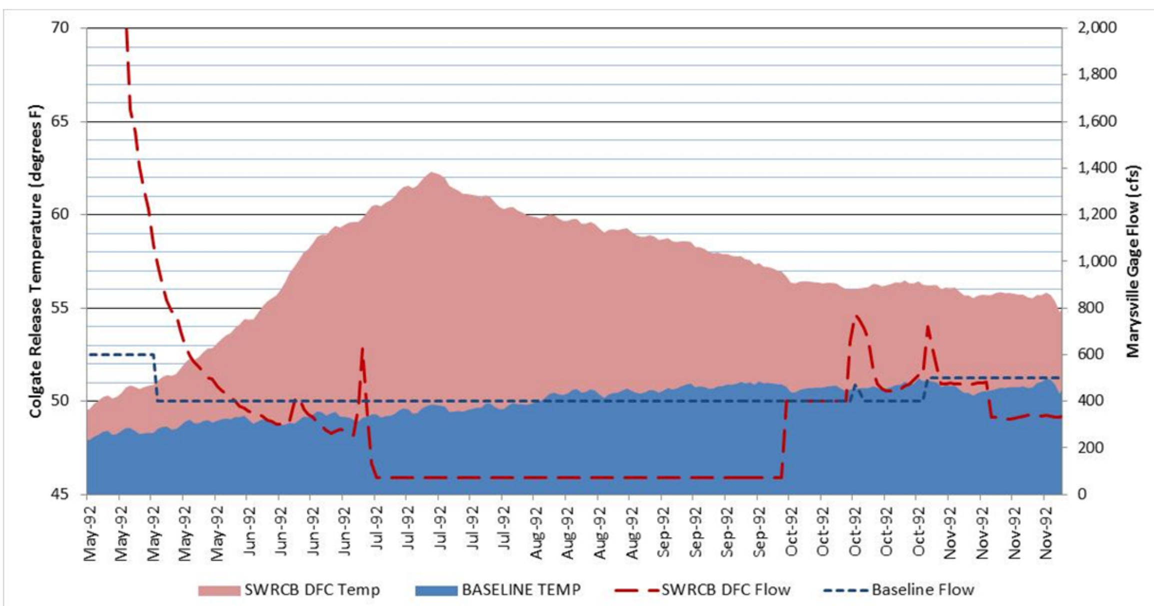

Figure 3.3-6. Simulated Colgate Powerhouse Release Water Temperature and Flow in the Lower Yuba River at the Marysville Gage during 1992 under the SWRCB DFC Scenario Compared to the Baseline Condition

3.3.3 Expected Water Temperatures in the Lower Yuba River under the SWRCB DFC due to Low Flows and High Release Temperatures in Conference Years

New Bullards Bar Reservoir is a deep, steep-sloped reservoir that persistently contains a large volume of coldwater pool storage. Historically, the New Bullards Bar Dam multi-level outlet was used to release water from both the upper warmer and lower colder regions of the reservoir.

In 1993, YCWA convened a water temperature advisory committee comprised of representatives from CDFG and USFWS. Pursuant to input provided by this committee, the low-level outlet has been used for all controlled releases from New Bullards Bar Dam since September 1993. Prior to that time the upper level outlet was used periodically. The coldwater pool availability in New Bullards Bar Reservoir has been sufficient to accommodate year-round utilization of the low-level outlet to provide cold water into Englebright Reservoir, and subsequently into the lower Yuba River (RMT 2010).

A "depleted state" of storage in New Bullards Bar Reservoir can be characterized as storage below 300,000 acre-feet. The SWRCB DFC scenario would result in New Bullards Bar Reservoir storage dropping to a depleted state on five occasions, and approaches a depleted state a sixth time, within the 29-year simulation period. Thus, the cold-water pool in New Bullards Bar Reservoir would be depleted in half of all dry and critical years (5 of 10) under the SWRCB DFC scenario. Due to the persistent nature of California droughts, New Bullards Bar Reservoir storage would have remained at a depleted state 65 percent of the time during the more than 5-year span extending from the fall of 1987 to 1993.

As previously demonstrated, the temperature of the water released from New Bullards Bar Reservoir at the Colgate Powerhouse ranges from 46 to 52 degrees F under the Baseline Condition over the entire 29-year period of evaluation, with the exception of the extreme drought year of 1977. In contrast, the Colgate Powerhouse release temperature under the SWRCB DFC scenario is estimated to be about 10 degrees warmer during the summer and fall than under the Baseline Condition.

Coldwater releases from New Bullards Bar Reservoir dictate release temperatures from Englebright Reservoir to the lower Yuba River. Higher release temperatures under the SWRCB DFC scenario also coincide with substantially lower flow during the summer and fall of the driest years, exacerbating the water temperature conditions of the lower Yuba River.

For this report, no lower Yuba River flow temperature analysis was done beyond the analysis of New Bullards Bar Reservoir release temperatures. However, historical flows and temperature conditions do provide some indication of the range of water temperatures that would be expected with the lower flow and the higher release temperatures that result for the SWRCB DFC scenario in some years.

Water temperature recordings for June 2001 in Figure 3.3-4 demonstrate the magnitude of temperature increase that could occur under lower flow conditions. Another example is from flow and temperature recordings from 1992. At that time, YCWA periodically took reservoir temperature profile readings as well as readings at various locations on the lower Yuba River and also maintained temperature recordings for the powerhouse penstocks. **Figure 3.3-7** is a chart comparing readings from 1992. During this critical water year, flows were low for July and August and releases were being made to comply with the FERC license required minimum instream flow of 70 cfs, which was the controlling minimum flow for that time. Although YCWA formally began utilizing the lower level outlet of New Bullards Bar Dam exclusively in 1993, the temperature records for 1992 suggest that the lower level outlet was used in this year as well; the release temperature from Colgate Powerhouse ranged from 46 to 49 degrees F all summer. Figure 3.3-7 demonstrates that with July and August flows of just under 100 cfs, and with cold releases from New Bullards Bar Reservoir, the temperature at the Marysville Gage is above 70 degrees F and as high as 73 degrees F. Historical water temperature data from 1990 indicates that when the upper level outlet was being used in the summer, and release temperatures from New Colgate Powerhouse were at 60 degrees F, (July 1990) and flows were 275 cfs at the Marysville Gage, the water temperature at Marysville was about 77 degrees F. This information suggests that the lower flows of Conference Years, together with the higher release temperatures of a depleted cold pool as seen in the SWRCB DFC scenario, would likely result in Yuba River temperatures at Marysville in the mid-to-upper 70 degree F range in the summer.

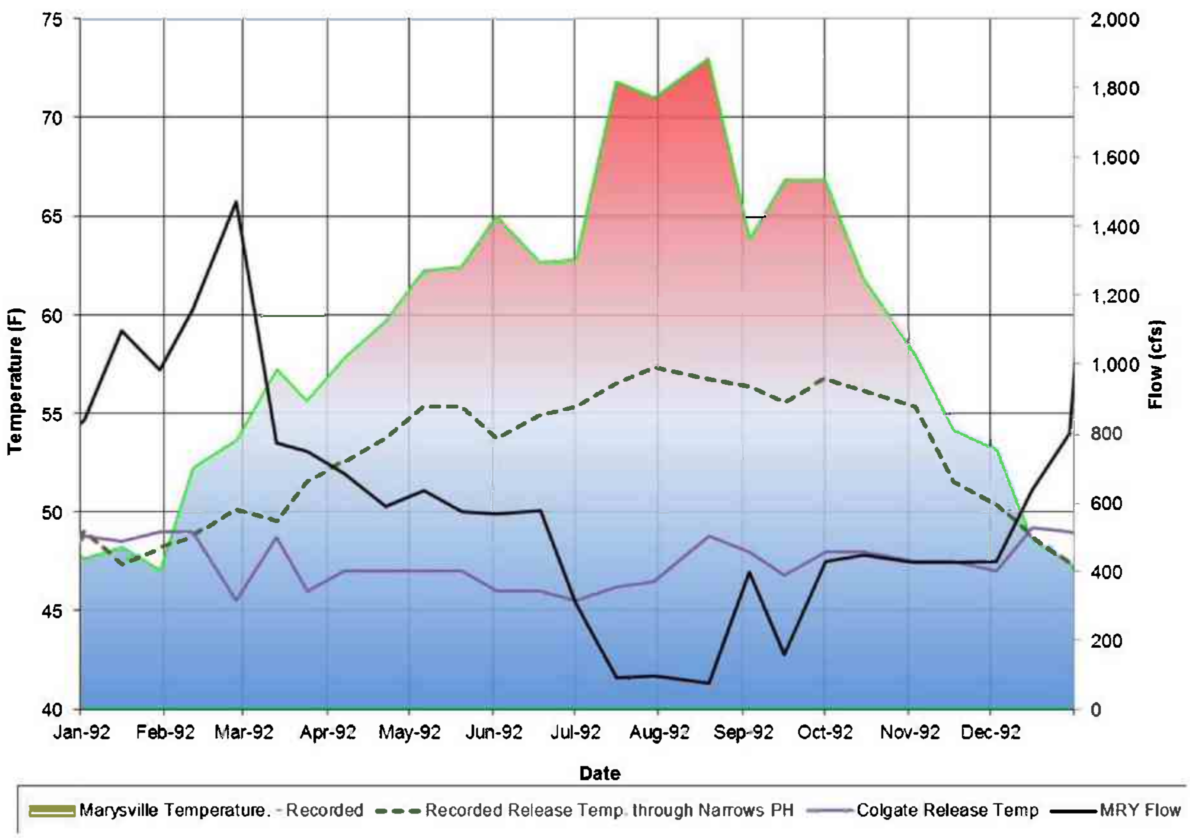

Figure 3.4-7. Powerhouse Release Temperatures, Yuba River Water Temperatures and Flow at Marysville Gage for 1992

3.4 YUBA COUNTY WATER AGENCY IRRIGATION DELIVERIES

A time series of daily demands was developed in the hydrologic model of the Yuba River system to compare the Baseline Condition to the SWRCB DFC scenario. The daily time series includes a present level of development demand. **Figure 3.4-1** shows a comparison of the synthetic present level daily demand time series, compared to the historical daily deliveries for 2004 through 2007.

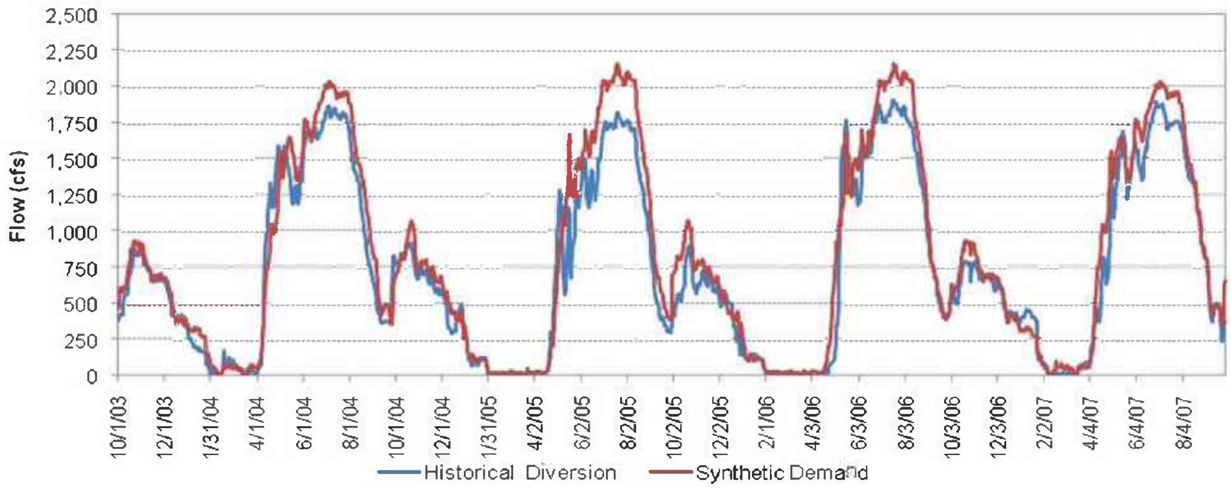

Figure 3.4-1. Comparison of Historical Deliveries and a Synthetic Demand for Present Level of Development

The daily time series representing the synthetic present level of demand used in the hydrologic model closely follows the trend and shape of the historical deliveries from 2004 through 2007. Although the synthetic daily time series demand rate is somewhat higher than the historical diversion rates, particularly during July and August, these differences do not impart a bias into the analysis. The synthetic demand daily time series is used in both the Baseline Condition, and in the SWRCB DFC scenario at the present level of demand, for the purposes of assessing changes in streamflow in the lower Yuba River associated with implementing the SWRCB DFC.

The SWRCB DFC would have a direct and consequential effect on the amounts of water stored in New Bullards Bar Reservoir throughout the 29-year simulation period. During drier years, the large reductions in storage would result in substantially reduced irrigation deliveries and flows in the lower Yuba River, compared to the Baseline Condition.

Agricultural irrigation deliveries are made at Daguerre Point Dam. The SWRCB DFC would have a very large impact on the availability of water for irrigation in Yuba County. Historically, irrigation water supplies from the Yuba River for local needs have been reliable, primarily due to a comparatively low percentage of irrigation demand volume to Yuba River available runoff volume. The available runoff volume is the amount of water available to the lower Yuba River after upstream diversions and lower Yuba River instream flows. The present annual irrigation diversion demand is about 305,000 acre-feet while the average annual runoff available to the lower Yuba River before allocations for instream flow is about 1,830,000 acre-feet. The average annual flow requirement at Marysville Gage for the Yuba Accord is 443,000 acre-feet, so the average annual volume of runoff available for irrigation deliveries is 1,387,000 acre-feet. Because most of this runoff occurs in the winter and spring, only a portion of this volume can be captured in New Bullards Bar Reservoir for later release.

In the development of the Yuba Accord, it was determined by biologists that the available water for instream flows, if all irrigation demands were met, would not be enough to maintain fish in good condition in the driest years. Therefore, two mechanisms were developed to ensure the availability of water for instream flows for the full range of hydrology. First, as part of the Yuba Accord, a conjunctive use program was developed that includes agreements with seven of the Member Units of YCWA. These agreements call for maintaining the groundwater basin in a healthy state so that, if diversion shortages are imposed, groundwater can be used to make up some or all of the shortage. Modeling completed for the Yuba Accord Environmental Impact Report/Environmental Impact Statement (YCWA et al. 2007; 2008) showed that shortages would be expected to occur in about 1 in 8 years, on average, for future demands of approximately 345,000 acre-feet. The Conjunctive Use Agreements also call for the pumping of 30,000 acre-feet of groundwater for irrigation in Schedule 6 years, and for a corresponding amount of water to be released from New Bullards Bar Reservoir storage in the summer when flows would be at their lowest to maintain suitable flows and water temperatures for spring-run Chinook salmon and steelhead holding and rearing in the river.

Under the SWRCB DFC, the frequency and magnitude of shortages would be so great that conjunctive use would not be able to replace the lost irrigation supplies. It is estimated that the annual irrigation pumping capacity of groundwater in the Member Unit area is about 120,000 acre-feet per year, but the basin cannot sustain this amount of pumping on a recurring basis. The SWRCB DFC scenario would result in irrigation shortages in all but one year of the 29-year simulation. Shortages would occur due to two conditions: (1) if New Bullards Bar Reservoir storage will not meet the end-of-September carryover storage target, then a shortage is imposed for the current irrigation season until the following April; and (2) a daily imposition of cuts to irrigation deliveries could be needed to meet the SWRCB DFC standard at Marysville. Irrigation deliveries start in earnest in May when flood-up for rice occurs and when latent soil moisture no longer supports tree and truck crop growth. Since the SWRCB DFC would be imposed until the end of June and the criteria would be a high percentage of unimpaired flow, there would not be enough release capacity to meet the SWRCB DFC and irrigation deliveries. The result would be irrigation delivery shortages in the spring of almost all but the driest years, and the shortage would be greatest in the wettest years.

The SWRCB DFC scenario would result in an annual average shortage in irrigation deliveries of 73,500 acre-feet per year, or 24 percent of demand. In two separate 6-year cycles of 1977 to 1982 and 1987 to 1992, the average annual shortages would be 103,582 acre-feet and 122,522 acre-feet, respectively. Although 1977 is the driest year of record, only one of the other five years for 1977 to 1982 is dry, but, four of these other years also would have significant shortages due to the nature of the SWRCB DFC. Under Baseline Conditions, the average shortage in the 1977 to 1982 period is 33,105 acre-feet, and is a result of 1977 shortages that continue into early 1978. The Baseline Condition flow scenario has no shortages in the 1987 to 1992 period.

Figure 3.4-2 is a graph of annual irrigation demand shortages as a percentage of the irrigation demand for the Baseline Condition and SWRCB DFC scenario.

The annual average shortage for the two six-year periods with the SWRCB DFC scenario are significantly greater than could be supported by groundwater pumping from the Yuba Subbasin without resutling in overdraft. This conclusion is based on the fact that the Yuba South Subbasin was in overdraft before 1983, and estimated annual pumping volumes at that time were in the range of the shortages stated for the six-year periods.

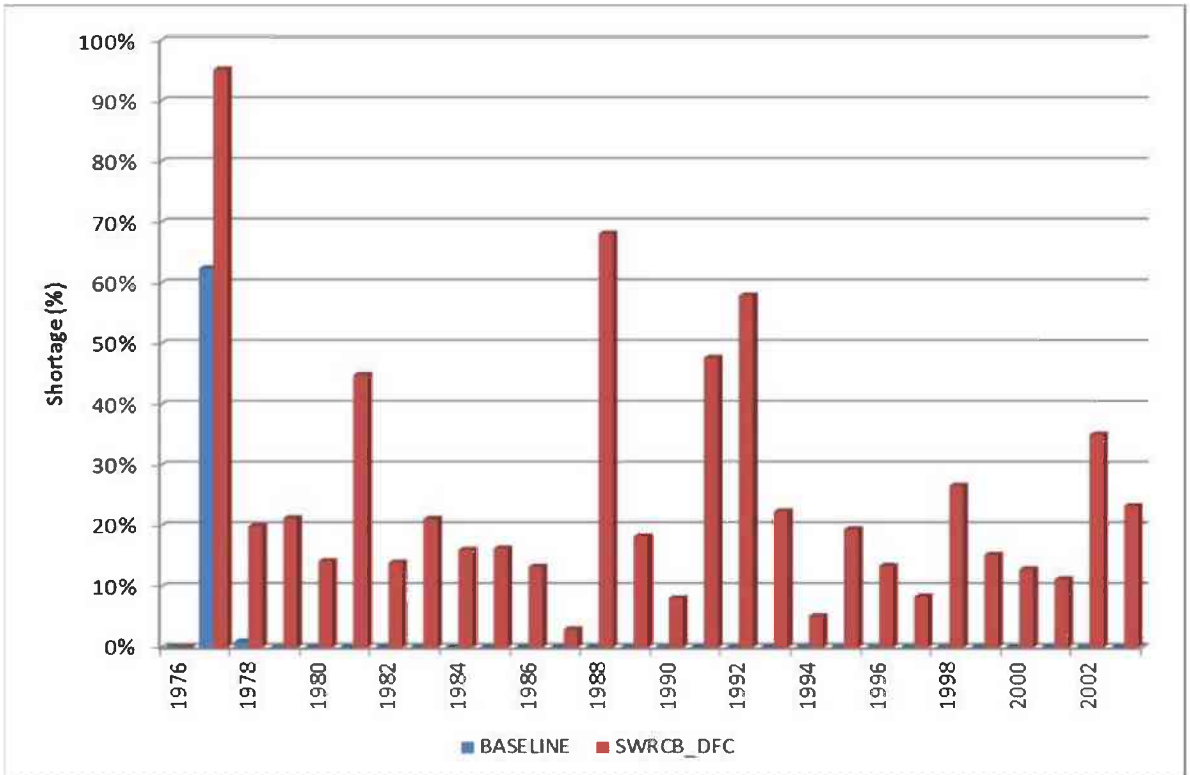

Figure 3.4-2. Annual Irrigation Shortages as a Percent of Demand

3.5 COLGATE POWERHOUSE GENERATION

The SWRCB DFC would have a substantial effect on the timing of releases from New Bullards Bar Reservoir through New Colgate Powerhouse and from Englebright Reservoir through the Narrows 1 and 2 Powerhouses. These changes in release timing would affect the amount and timing of power generation. Because the SWRCB DFC would result in substantially higher flows in March through May of most years, and lower flows at other times, power generation would be shifted coincident with these shifts in flows. **Figure 3.5-1** shows the monthly average generation from New Colgate Powerhouse under the two modeled scenarios.

In dry and critically dry years, the effect on generation would be more pronounced, with the shift in generation from summer peak load times to lower power demand times of the spring. **Figure 3.5-2** shows the monthly average generation from New Colgate Powerhouse for dry and critical water years.

The percentage change in monthly generation from the Baseline conditions to the SWRCB DFC scenario for the long-term average and for dry and critical years is shown in **Table 3.5-1**.

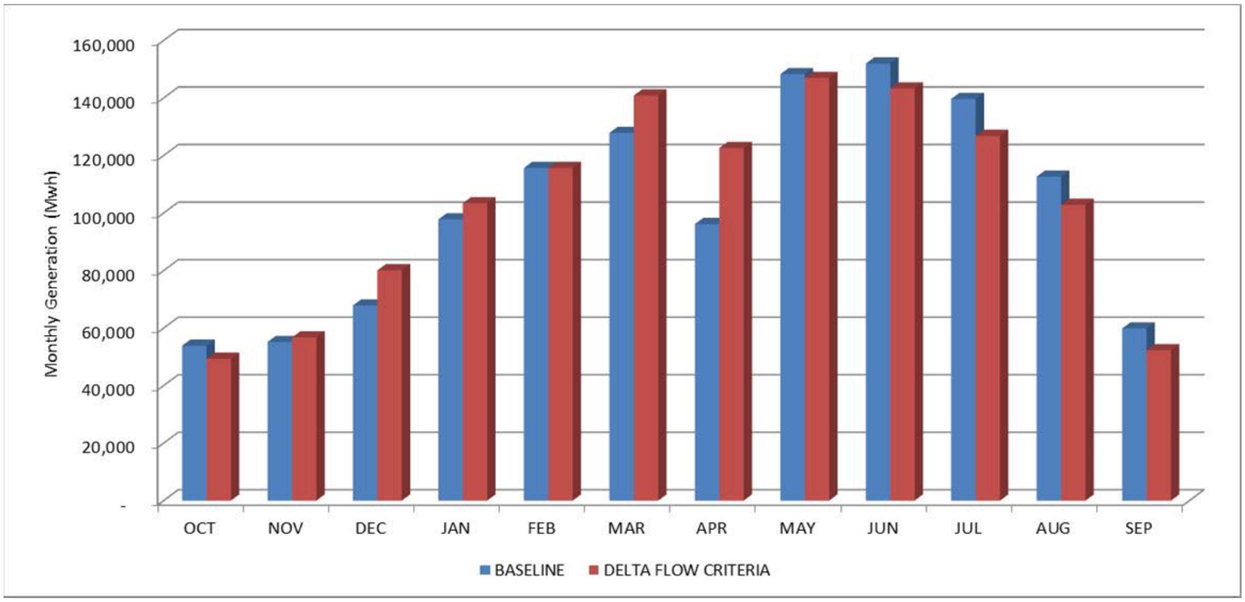

Figure 3.5-1. Simulated Average Monthly New Colgate Powerhouse Generation

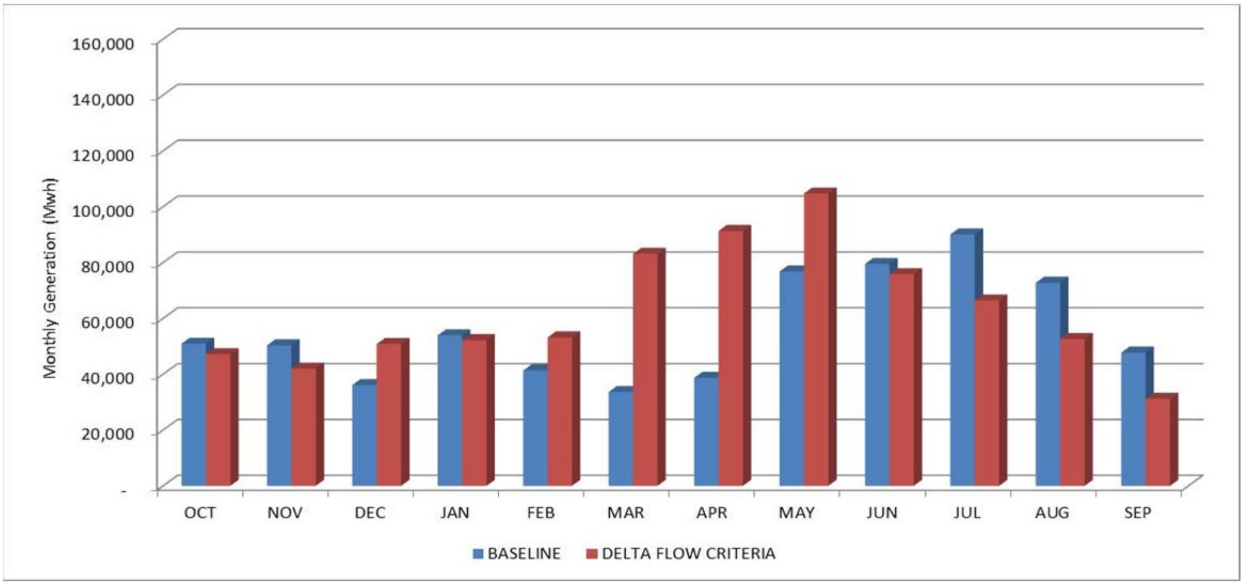

Figure 3.5-2. Simulated Average Monthly New Colgate Generation - Dry and Critical Years

Table 3.5-1. Change in Average Monthly Colgate Powerhouse Generation from Baseline Scenario to the SWRCB DFC Scenario (Percent)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Percent Change	-8	3	18	6	0	10	27	-1	-6	-9	-9	-13
Dry Percent Change	-7	-16	41	-3	29	147	136	36	-5	-26	-28	-35

3.6 DELTA INFLOW CONTRIBUTION

The SWRCB DFC would result in substantial changes to outflows from the Yuba River. In general, modeling shows that, although the intent of the SWRCB DFC would be to increase flows to the Delta from the Sacramento River for November through June, the effect of the modeled criteria would be to increase flows for the Yuba River primarily in the months of April and May and sometimes March and June, in all but the wettest years. In other months, effects of the SWRCB DFC flows would be mixed, with flow reductions occurring about as frequently as flow increases. For the July through October period, the SWRCB DFC would result in flow reductions most of the time. **Table 3.6-1** lists the monthly average changes in Yuba River outflow due to implementation of the SWRCB DFC. The table has been color coded with red signifying months of reduced flow in the SWRCB DFC scenario, yellow indicating months with equal flows, and green for months when flows for the SWRCB DFC scenario are greater than the Baseline condition.

Table 3.6.1. Simulated Change in Yuba River Monthly Average Outflow with the SWRCB DFC

		Delta Flow Criteria Period										
WY	**OCT**	**NOV**	**DEC**	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**
1977	-	(245)	(165)	(60)	(38)	(37)	378	1,041	227	(0)	(0)	(329)
1976	116	576	306	92	361	1,007	1,304	1,412	14	(0)	(0)	-
1987	107	(143)	(31)	29	786	1,542	2,841	1,196	(15)	-	0	-
1994	18	(102)	190	138	260	1,830	2,268	2,053	126	-	(0)	-
1992	(30)	(99)	(115)	(96)	906	1,696	3,169	822	(52)	(321)	(330)	(330)
1988	-	(238)	918	822	793	1,354	1,882	1,268	474	(78)	(80)	(280)
2001	9	(117)	41	57	157	1,825	2,454	2,506	41	-	-	-
1981	7	(130)	535	490	950	1,460	2,862	1,816	204	(0)	(0)	89
1991	(25)	(248)	(182)	(149)	(140)	1,222	2,911	3,201	1,728	(232)	(450)	(343)
1990	(18)	174	337	219	105	1,842	3,155	1,670	1,182	-	(0)	(197)
1985	0	946	(3)	47	(11)	420	3,536	2,528	367	(0)	0	2
2004	(29)	(114)	934	(420)	251	1,458	2,727	2,290	344	0	-	-
2002	-	203	855	477	542	1,319	3,001	2,746	939	(100)	(204)	(261)
1979	7	(114)	(11)	241	61	858	2,330	3,032	93	(277)	(334)	(11)
1989	90	457	552	567	1,146	1,762	723	1,959	888	(0)	(255)	(250)
2000	8	5	510	896	465	187	2,556	2,719	1,253	224	58	-
2003	(71)	932	1,127	7	(338)	986	2,519	2,605	(443)	(869)	(439)	(236)
1999	10	471	5	380	371	599	1,896	3,264	1,488	450	109	-
1993	56	(97)	179	1,087	(224)	1,324	883	2,823	427	1	(3)	-
1978	(24)	(11)	913	1,474	463	114	688	1,804	2,089	467	78	-
1984	79	2,063	1,061	440	335	1,116	2,023	2,027	602	(1)	30	35
1980	(21)	442	447	2,153	302	96	1,460	1,719	1,321	672	139	-
1996	13	(106)	1,108	10	2,031	1,191	1,830	1,154	753	567	177	-
1986	3	41	716	1,751	1,039	345	1,129	1,708	519	(1)	12	160
1998	-	180	614	1,248	(483)	1,217	1,394	2,526	2,435	656	81	15
1997	20	866	1,472	132	(35)	715	2,376	1,390	(166)	(1)	-	-
1995	-	(16)	553	1,163	(1,032)	(1,685)	1,533	2,021	1,346	759	174	13
1983	737	866	403	43	(107)	674	544	3,124	1,775	770	254	160
1982	69	3,043	(2,205)	(149)	1,417	576	178	1,582	1,187	238	40	15

Key: Values in cfs
Green = increase, Yellow= small change, Red = decrease

The analysis of the SWRCB DFC, as well as the analysis of other flow criteria based on other percentages of unimpaired flow as described later in this report, show the disconnect between the relative increase in Yuba outflow and the resulting Delta inflow, and the severity of impacts in the Yuba River watershed in many years. More specifically, in some years the increased Yuba River outflow under the various scenarios as compared with Baseline Condition outflow may not be very large on a percent increase basis, while the impacts to storage and flows in the summer and fall are quite large. This is due to increased outflow under the SWRCB DFC compared to the Baseline Condition when the Baseline Condition outflow is already large. As an example, an increase in outflow of 500 cfs for a SWRCB DFC scenario when the Baseline Condition outflow is already several thousand cfs is a modest increase as a percentage, while a reduction of 500 cfs diversion to storage in New Bullards Bar Reservoir can have a substantial effect on resulting summer flows and irrigation deliveries. In addition, impacts to storage accumulate over both a season and over multiple years. This accumulation of storage impacts over more than one year results in the depletion of storage.

Another effect of the SWRCB DFC is to make wetter years following a dry year drier, and sometimes this change can be substantial. When storage is depleted in a dry year due to the SWRCB DFC, the reduced storage for the following year results in an operation where all allowable flow that can be diverted to storage is diverted, while under Baseline Conditions, runoff is released to the lower Yuba River because storage has not depleted. The SWRCB DFC has the effect of "flipping" wet years to drier flow years and making drier years appear wetter. This condition tends to occur in the late fall and winter.

3.6.1 American, Bear and Feather River Impacts

As described in Section 2.1, simplifying assumptions are made for modeling the upper watershed flow. One simplification is, under the Baseline Condition, no attempt is made to track the ultimate disposition of the upper Yuba River watershed diversions to other watersheds. For the SWRCB DFC scenario, a blanket assumption is made that 75 percent of the unimpaired flow would be bypassed by upstream facilities and would flow to the lower Yuba River. This assumption leads to an overestimation of Delta flow increases and an underestimation of the flow reductions for the SWRCB DFC scenario compared with Baseline Conditions. Approximately 510,000 acre-feet per year on average is diverted from the North, Middle and South Yuba rivers to the Feather, Bear, and American river watersheds. Some of this water is consumptively used in these watersheds and some of this water flows to the Sacramento River. Using the assumption of 75 percent of unimpaired flow being bypassed or released from upper watershed facilities results in an average annual increase of 270,000 acre-feet of lower Yuba River inflow that would otherwise have been diverted out of the Yuba River watershed. This would represent slightly more than one half of the total volume of out-of-basin diversions under Baseline Conditions. The increased lower Yuba River flow would result in a either a corresponding volume of consumptive use reductions or reductions in outflows from these other rivers. Given the nature of the water supplies and facilities of these other river systems, it is likely that the result would be reduced outflows from these rivers, primarily during March to June. Accordingly, the results in Table 3.6-1 may overstate the overall Delta outflow benefits, and understate the overall Delta outflow impacts of the SWRCB DFC by an average of up to 270,000 acre-feet per year.

3.7 OTHER PERCENTAGES OF NATURAL FLOW AS A FLOW CRITERIA

In addition to analyzing the SWRCB DFC with a 75 percent of unimpaired flow outflow requirement, scenarios with 60 percent and 50 percent of unimpaired flow as an outflow requirement were evaluated. These two scenarios were simulated using the same approach as the 75 percent of unimpaired flow scenario with the exception that the Yuba River outflow requirement from November through June was set at 60 percent of unimpaired Yuba River flow for the 60 percent scenario, and at 50 percent of unimpaired Yuba River flow for the 50 percent scenario.

3.7.1 Sixty Percent of Unimpaired Flow from November through June as a Required Yuba River Outflow

The 60 percent scenario results in impacts that are similar in magnitude to the 75 percent of unimpaired flow scenario, but in fewer years. **Figure 3.7-1** shows storage in New Bullards Bar Reservoir for the Baseline Condition and 60 percent scenario.

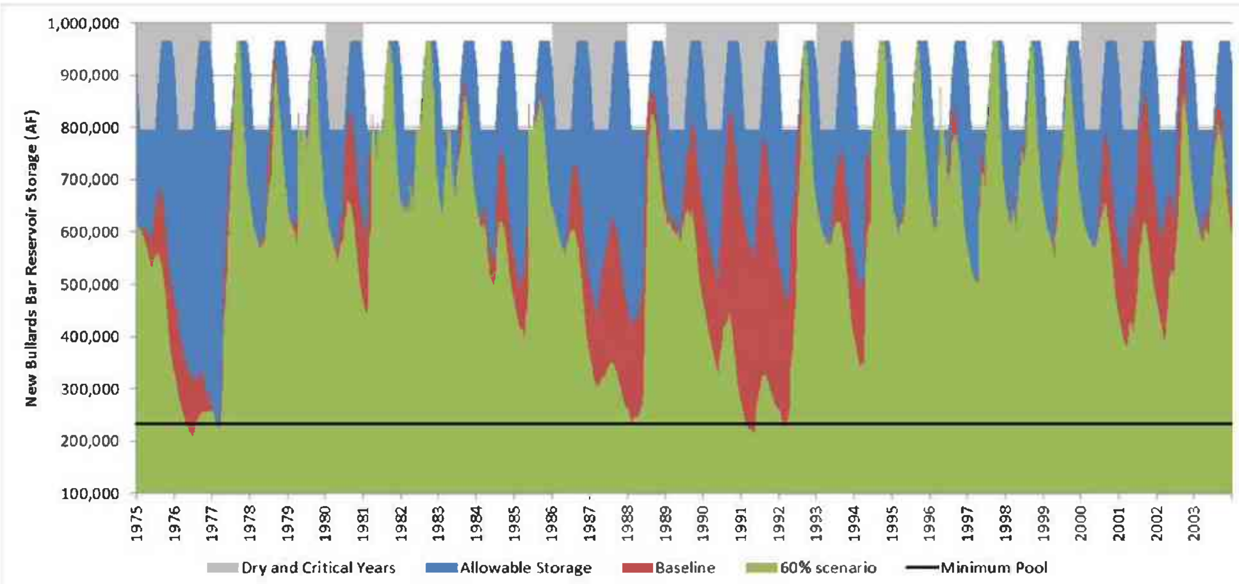

Figure 3.7-1. New Bullards Bar Reservoir Storage under the 60 Percent Scenario Compared to the Baseline Condition

In Figure 3.7-1, the top of the green shading indicates the simulated New Bullards Bar Reservoir storage levels under the 60 percent scenario, the top of the red shading indicates the simulated New Bullards Bar Reservoir storage levels under the Baseline Condition, and the top of the blue shading indicates the maximum authorized New Bullards Bar Reservoir storage amounts under the applicable flood control criteria.

The resulting New Bullards Bar Reservoir storage under the 60 percent scenario indicates storage is depleted in four years and almost depleted in a fifth year (1987) for this level of unimpaired flow. For years with depleted storage, effects on lower Yuba River flows and temperatures and resulting habitat conditions would be similar to the conditions that would occur under depleted storage conditions for the 75 percent scenario. In addition to effects on storage, the following is a summary of the impacts of the 60 percent scenario as compared to the Baseline Conditions:

- New Bullards Bar Reservoir storage is depleted in three additional years
- Yuba Accord flow schedules are shifted to lower flow schedules in 6 years (20 percent of years)
- Two additional Conference Years (3 total in 29 years or about 10 percent of years)

- Substantially elevated temperatures in the lower Yuba River in the summer of the Conference Years, which also have a depleted New Bullards Bar Reservoir coldwater pool
- Irrigation delivery shortages in the spring of all years and substantially increased annual shortages in 6 years (20 percent of all years)
- Power generation shifted from the summer to spring, with the greatest impact in drier years

While the 60 percent scenario results in the impacts listed above, increased Yuba River outflow is mostly limited to April and May, and much of this increased outflow is due to curtailment of the out of upper Yuba River basin diversions to the Bear and American rivers. The resulting outflows for March and June are mixed, with 60 percent scenario flows both slightly higher and slightly lower than Baseline Conditions depending upon the year. The other months where the outflow requirement applies (November through February) see no substantial change in probability of outflow, and in some years, especially drier years, outflow is lower for the 60 percent scenario.

3.7.2 Fifty Percent of Unimpaired Flow from November through June as a Required Yuba River Outflow

The 50 percent scenario results in impacts similar in magnitude to the 75 percent scenario. New Bullards Bar Reservoir storage is fully depleted in three years, and almost fully depleted in a fourth year. This fourth year, 1991, is characterized as a year with depleted storage since the volume of water left in storage at the end of the water year is 330,000 acre-feet, but New Bullards Bar Reservoir storage continued to decline with the lowest storage volume within 30,000 acre-feet of the dead pool. **Figure 3.7-2** shows storage in New Bullards Bar Reservoir for the Baseline Condition and 50 percent scenario.

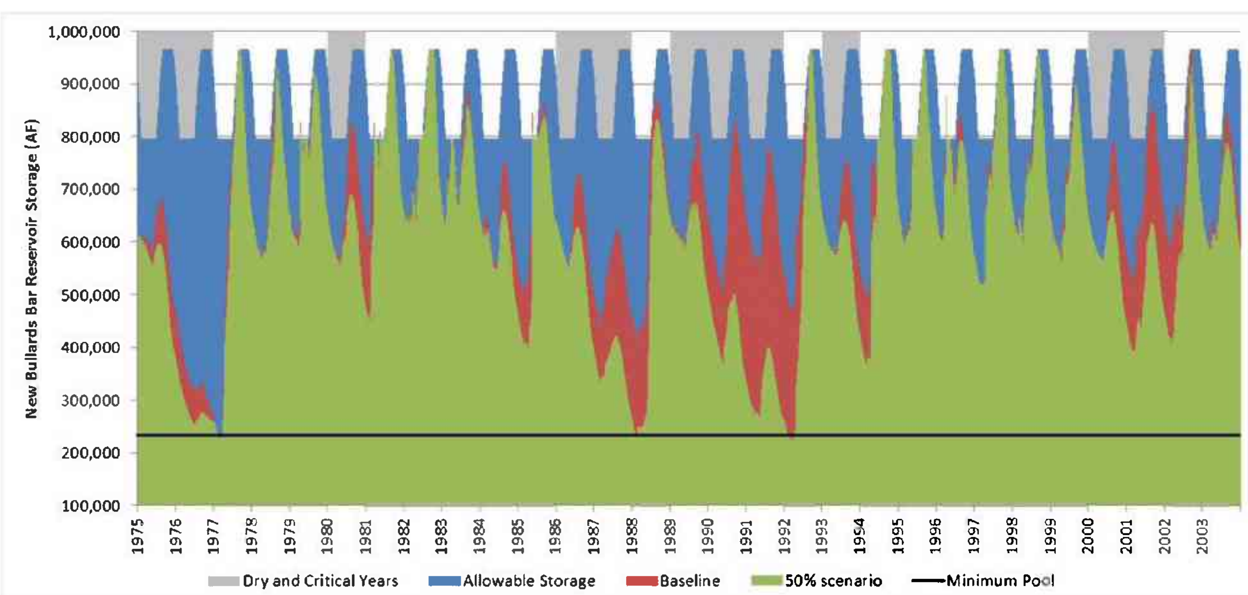

Figure 3.7-2 New Bullards Bar Reservoir Storage under the 50 Percent Scenario Compared to the Baseline Condition

In Figure 3.7-2, the top of the green shading indicates the simulated New Bullards Bar Reservoir storage levels under the 50 percent scenario, the top of the red shading indicates the simulated New Bullards Bar Reservoir storage levels under the Baseline Condition, and the top of the blue shading indicates the maximum authorized New Bullards Bar Reservoir storage amounts under the applicable flood control criteria.

New Bullards Bar Reservoir storage resulting from the 50 percent scenario is depleted in three years and almost depleted in a fourth year (1991). Effects on lower Yuba River flows and temperatures and resulting habitat conditions for these years would be similar to conditions occuring under depleted storage conditions for the 75 percent scenario. In addition to effects on storage, the following is a summary of changes comparing the 50 percent scenario to the Baseline Condition.

- New Bullards Bar Reservoir storage is depleted in three additional years
- Yuba Accord flow schedules are shifted to lower flow schedules in 5 years (15 percent of years)
- One additional Conference Year; however, an additional year, 1988, is so close to becoming a Conference Year that it is likely that this year would also be a Conference Year
- Substantially elevated water temperatures in the lower Yuba River in the summers of Conference Years, which also have a depleted New Bullards Bar Reservoir coldwater pool
- Irrigation delivery shortages in the spring of all years and substantially increased annual shortages in 3 years (10 percent of all years)
- Power generation shifted from the summer to spring, with the greatest impact in drier years

While the 50 percent scenario results in the impacts listed above, the occurrence of increased Yuba River outflow is primarily limited to April with some increased outflow in May of drier years. Most of the increased outflow is due to curtailment of the out-of-upper Yuba River basin diversions to the Bear and American rivers. Under the 50 percent scenario, the effect on the YRDP is limited to modest increases in releases from New Bullards Bar Reservoir in April, and generally lower releases in the drier years of the rest of the months of November through June. The 50 percent scenario outflow requirement for November through June, except April effectively results in lower flows in wetter years and mixed results of modest changes in drier years. A general characterization is that in most months udner the SWRCB DFC, the outflow requirement does not substantially change the probability of outflow, and in some years, especially drier years, Yuba River outflow is lower for the 50 percent scenario.

In summary, the primary effect of the 50 percent scenario on the YRDP is a reduction in New Bullards Bar Reservoir storage, depleting it to below 300,000 acre-feet in three years, shifting the Yuba Accord flow schedules to lower flows in 5 years, and resulting in at least one, and more likely two, additional Conference Years compared to Baseline Conditions. There would not be any significant benefit to Delta inflow, other than increases in April, but with slightly lower inflow at other times.

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APPENDIX A

BIOLOGICAL TECHNICAL MEMORANDUM

1 INTRODUCTION

The overall purpose of this Technical Memorandum is to assess potential effects of implementation of the SWRCB Delta Flow Criteria (DFC) on biological resources of the lower Yuba River, particularly spring-run Chinook salmon, fall-run Chinook salmon and steelhead. The State Water Resources Control Board (SWRCB) adopted Resolution 2010-0039 on August 3, 2010, approving the report titled, "*Development of Flow Criteria for the Sacramento-San Joaquin Delta Ecosystem*" (SWRCB Report).

The SWRCB Report identifies the following criteria, expressed as percentages of natural (unimpaired) flows:

- 75 percent of unimpaired Delta outflow from January through June
- 75 percent of unimpaired Sacramento River inflow from November through June
- 60 percent of unimpaired San Joaquin River inflow from February through June

The Yuba River is a tributary to the Sacramento River and contributes flow to the cumulative Sacramento River inflow to the Delta, and to Delta outflow. Therefore, the analysis contained herein focuses primarily on the effects of implementing the first two SWRCB Delta Flow Criteria. Furthermore, because the SWRCB Report did not recommend the proportion of unimpaired flow that each Sacramento River tributary would be responsible for contributing to the cumulative 75 percent Sacramento River inflow, this analysis assesses potential effects of contributing 75 percent of the Yuba River unimpaired flow to the Sacramento River inflow from November through June.

2 BACKGROUND

2.1. SPECIES OF EVALUATION

This technical memorandum focuses primarily on three salmonid species including the Central Valley Distinct Population Segment (DPS) of steelhead[1] *(Oncorhynchus mykiss)*, as well as two

[1] The Central Valley DPS of steelhead was listed as a federally threatened species on January 5, 2006 (71 FR 834). Critical habitat was designated on September 2, 2005 including the lower Yuba River (70 FR 52488) from its confluence with the lower Feather River upstream to Englebright Dam.

Central Valley Evolutionarily Significant Units (ESUs) of Chinook salmon *(Oncorhynchus tshawytscha)* - spring-run[2] and fall-/late fall-run[3]. Central Valley steelhead are listed as "threatened" under the federal Endangered Species Act (ESA). It is recognized that both the anadromous (steelhead) and resident (rainbow trout) life histories are expressed by *O. mykiss* in the Yuba River downstream of Englebright Dam. This technical memorandum focuses on effects to anadromous, sea-going steelhead in its analysis.

The lower Yuba River is utilized by two principal Chinook salmon runs (i.e., fall-run and spring-run Chinook salmon). Central Valley spring-run Chinook salmon are listed as "threatened" under the federal Endangered Species Act (ESA) and the California Endangered Species Act (CESA), and Central Valley fall-/late fall-run Chinook salmon are listed as a federal Species of Concern and a state Species of Special Concern. Although late fall-run Chinook salmon populations occur primarily in the Sacramento River (CDFG Website 2007), incidental observations of late fall-run Chinook salmon have been reported to occur in the lower Yuba River (D. Massa, CDFG, pers. comm. 2009; M. Tucker, NMFS, pers. comm. 2009). However, the lower Yuba River is believed not to sustain a persistent population of late fall-run Chinook salmon. During 2008, six Chinook salmon adults were recovered during the late-winter and early-spring portion of the escapement surveys with Coded Wire Tags (CWTs) demonstrating that these were late fall-run fish from the Coleman National Fish Hatchery located on Battle Creek. Although NMFS has designated one ESU that contains both fall-run and late fall-run Central Valley Chinook salmon, this evaluation focuses on fall-run Chinook salmon in the lower Yuba River.

Environmental parameters such as water temperature affect the distribution, growth and survival of fish populations. Water temperature regimes occurring in regulated rivers are controlled by climatologic and meteorologic conditions, the physical characteristics of the regulating dams and reservoirs, the volume, timing, and temperature of inflows to the reservoirs, and the release schedules associated with dam and reservoir operations. Water temperatures in the lower Yuba River downstream of Englebright Dam are influenced by the temperature of the water released from New Bullards Bar Reservoir to Englebright Reservoir, releases from Englebright Reservoir to the lower Yuba River, operations under the Yuba Accord Fisheries Agreement (magnitude, frequency, and duration of water releases), and natural mechanisms of heat transfer associated with characteristics of the physical environment (e.g., river geometry) and climate (e.g., ambient air temperatures).

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[2] The Central Valley ESU of spring-run Chinook salmon was listed as a federally threatened species on June 28, 2005 (70 FR 37160). Critical habitat was designated on September 2, 2005 (70 FR 52488) including the Yuba River from its confluence with the Feather River upstream to Englebright Dam. Spring-run Chinook salmon in the Sacramento River Drainage, including the Yuba River, was listed as a threatened species under CESA on February 2, 1999. In August 2011, NMFS completed a 5-year status review of the Central Valley spring-run Chinook salmon ESU and recommended that the listing remain as threatened.

[3] The Central Valley ESU of fall-/late fall-run Chinook salmon was included as a federal Species of Concern and state Species of Special Concern under the ESA and CESA in 2004 due to concerns about population size and hatchery influence (NMFS 2009).

2.2. DEVELOPMENT OF YUBA ACCORD INSTREAM FLOW SCHEDULES

Existing instream conditions in the lower Yuba River reflect implementation of the Lower Yuba River Accord. The development of the Yuba Accord was a collaborative process, which led to a comprehensive settlement of 20 years of litigation over lower Yuba River instream flow requirements and related issues. Stakeholders that participated in the development of the Yuba Accord include NMFS, CDFG, USFWS, YCWA, SYRCL, Trout Unlimited (TU), FOR and the Bay Institute. USACE (2011) reports that the Yuba Accord Technical Team pursued a variety of analytic techniques and tools, and performed numerous evaluations to develop minimum flow requirements, referred to as "flow schedules" for the lower Yuba River. Additionally, the Technical Team recognized that a new flow regime for the lower Yuba River would need to achieve several objectives which primarily focused on maximizing the occurrence of "optimal" flows and minimizing the occurrence of sub-optimal flows within the bounds of hydrologic constraints, and maximizing the occurrence of appropriate flows and water temperatures for Chinook salmon and steelhead in consideration of all freshwater lifestages.

The first step in developing the flow schedules was the development of an "optimal" flow schedule that was not constrained by water availability limitations. Available information such as the Stressor Matrix results (and the species and life stage rankings, life stage periodicities, and geographical considerations developed for the Stressor Matrix), flow-habitat relationships (i.e., weighted usable area [WUA]) for Chinook salmon and steelhead spawning, and an understanding of the lower Yuba River flow-water temperature relationship was utilized in this process.

The development of the "optimal" flow schedule resulted in a "high" (Schedule 1) and a "low" (Schedule 2) range of ideal flows. The development of the "high" and "low" range of ideal flows was representative of the variety of opinions among the Technical Team biologists. Through extensive discussion and collaboration, the Technical Team biologists and representatives came to a general agreement that the two flow schedules represented the range of the "optimal" flows.

The second step of the flow schedule development process was the development of a "worst case" flow schedule for years with extremely low water availability, targeting hydrologic year classes in the 5 percent of driest years. This flow schedule, which eventually became Schedule 6, was termed the "survival" flow schedule, because the Technical Team sought to develop a flow regime that would permit survival of the year's cohort during very dry hydrological conditions.

Recognizing the year-to-year variations in lower Yuba River water availability, the Technical Team developed three additional flow schedules (Schedules 3, 4, and 5) between the "optimal" flows and the "survival" flows to be used during intermediate hydrological conditions. The step size between each successive flow schedule was adjusted to be large enough to cover the ranges of water availability without excessive jumps between flow schedules. The Technical Team considered utilizing more or fewer than a total of six flow schedules. However, it was ultimately determined that six flow schedules could adequately address nearly the entire spectrum of hydrological occurrences.

Ultimately, six flow schedules, plus conference year provisions, were developed to cover the entire range of Yuba River Basin water availabilities. The flow schedules were developed to maximize fisheries benefits during wetter years, and to maintain fisheries benefits to the greatest extent possible for drier years while taking into account other key considerations such as water supply demands, flood control operations, and hydrologic constraints of the system (NMFS 2007). Conference Years are predicted to occur during the one percent driest hydrological conditions. The Yuba Accord contains provisions regarding the minimum flows, reductions in diversions for irrigation and consultations among representatives of interested parties and regulatory agencies that will occur during Conference Years.

2.3. EXISTING INSTREAM CONDITIONS IN THE LOWER YUBA RIVER

New Bullards Bar Reservoir, has a total storage capacity of 966 TAF with a minimum pool of 234 TAF (as required by YCWA's FERC license), thus leaving 732 TAF of capacity that can be regulated (RMT 2010). A portion of this regulated capacity, 170 TAF, normally must be held empty from September through April for flood control (YCWA *et al.* 2007). Throughout the period of operations of New Bullards Bar Reservoir (1970 through present), which encompasses the most extreme critically dry year on record (1977), the cold-water pool in New Bullards Bar Reservoir has not been depleted (DWR and PG&E 2010). In 1993, YCWA convened a water temperature advisory committee comprised of representatives from CDFG and USFWS. Pursuant to input provided by this committee, the low-level outlet has been used for all controlled releases from New Bullards Bar Dam since September 1993 (RMT 2010). The cold-water pool availability in New Bullards Bar Reservoir has been sufficient to accommodate year-round utilization of the lower river outlet to provide cold water into Englebright Reservoir, and subsequently into the lower Yuba River. Because Englebright Dam was constructed as a sediment retention facility, it does not contain a low-level outlet. Operational releases from Englebright Dam at RM 24 provide the base flow and water temperature boundary conditions in the upper reaches of the lower Yuba River. Lower Yuba River flows and water temperatures further downstream are affected by inflows from Deer Creek (RM 22.7) and Dry Creek (RM 13.6) during certain periods of the year, and by irrigation diversions at Daguerre Point Dam (DPD) (RM 11.6).

Additionally, substantial heat transfer into the lower Yuba River occurs as a result of surface water-air interaction and solar radiant heating. The river channel is generally wide and flat (except in the Narrows Reach) with little or no bank shading from riparian vegetation which promotes significant heat transfer at the water-air interface (YCWA *et al.* 2007). These high surface width-to-flow ratios also facilitate solar radiant heating. For the upper reaches of the lower Yuba River, releases from Englebright Dam at RM 24 provide the base flow and water temperature boundary conditions. Further downstream (RM 22.7 and below), lower Yuba River flows and water temperatures during certain periods of the year are affected by inflows from Deer Creek (RM 22.7) and Dry Creek (RM 13.6), and by irrigation diversions at Daguerre Point Dam (DPD) (RM 11.6). During warmer summer months water temperatures in the lower Yuba River generally increase in the downstream direction because a longitudinal gradient in water temperatures exists in the lower Yuba River. In the lower Yuba River, the lowest annual water temperatures are generally observed during January and February. Water temperatures increase until mid-June or July and remain at relatively high values through September and steadily decrease thereafter. The coldest water temperatures are observed upstream at the Smartsville Gage, intermediate water temperatures occur at Daguerre Point Dam, and the warmest temperatures are observed downstream at the Marysville Gage for most months of the year. The least amount of longitudinal variation in water temperature is observed during late fall through winter months (i.e., late November through February), when water temperatures are similar at the three monitoring locations (RMT 2010). Recent monitoring in the lower Yuba River during summer months (2006-2010) during which time operations have complied with the Yuba Accord, generally demonstrates water temperature from Smartsville increases on an average of about 5°F at DPD and 8°F at Marysville (**Figure 1**).

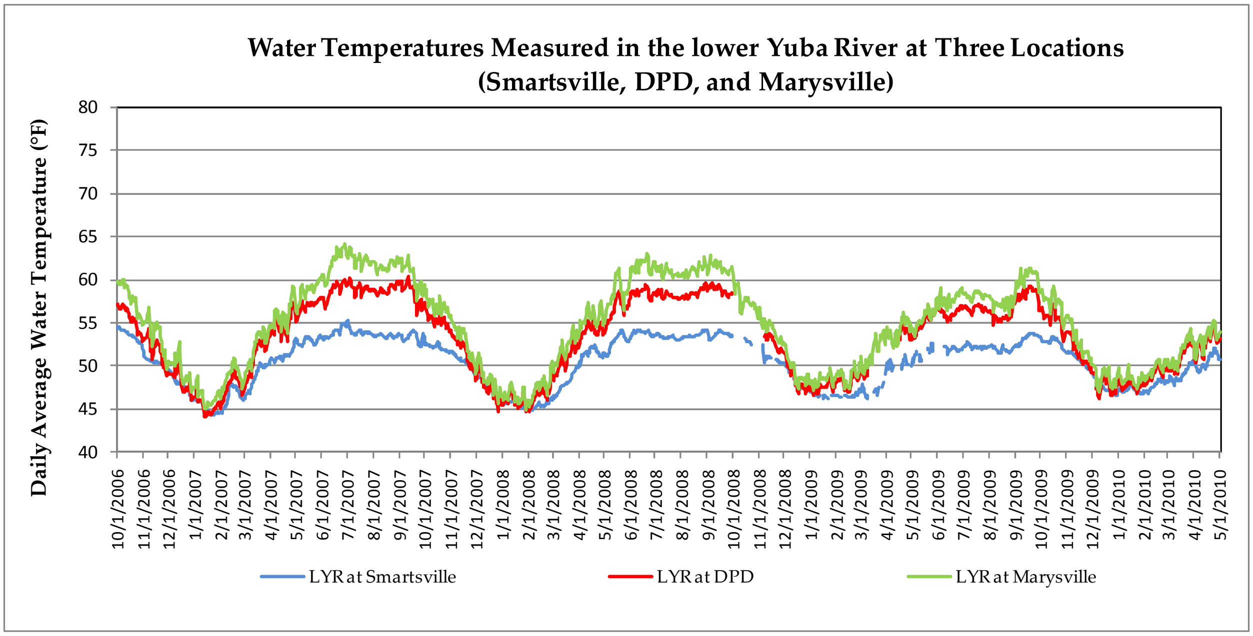

Figure 1. Longitudinal gradation of water temperatures measured at Smartsville, DPD, and Marysville monitoring locations in the lower Yuba River (RMT 2010).

2.4. Assessment of Water Temperature Suitability in the Lower Yuba River

The lower Yuba River is unique among Central Valley floor tributaries because implementation of the Yuba Accord provides generally suitable water temperatures for anadromous salmonids throughout the year, over a range of hydrologic and climatologic conditions (YCWA *et al.* 2007; RMT 2010). NMFS (2009) *Public Draft Recovery Plan for the Evolutionarily Significant Units of Sacramento River Winter-Run Chinook Salmon and Central Valley Spring-Run Chinook salmon and the Distinct Population Segment of Central Valley Steelhead* report that the lower Yuba River, below Englebright Dam, is characterized as having a high potential to support a viable independent population of spring-run Chinook salmon and steelhead primarily because, in addition to other factors, flow and water temperature conditions are generally suitable to support all life stage requirements.

The RMT evaluated water temperature suitability for steelhead, spring-run Chinook salmon, fall-run Chinook salmon, and North American green sturgeon in a technical memorandum titled *Lower Yuba River Water Temperature Objectives*, dated November 2010. The RMT (2010) report evaluated the suitability of current water temperatures in the lower Yuba River that are associated with implementation of the Yuba Accord for spring-run and fall-run Chinook salmon and steelhead by establishing specific water temperature index values for each lifestage based on a review of available literature, and by examining the thermal regime associated with implementation of the Yuba Accord by using the identified water temperature index values as general guidelines (RMT 2010).

The water temperature index values reported in RMT (2010) were founded on published thermal requirements of steelhead and Chinook salmon that were originally developed by research conducted on specific streams or under laboratory conditions that oftentimes focused on temperature maxima that cause lethal and sublethal effects. Also, research under controlled laboratory conditions does not take into account ecological considerations associated with water temperature regimes, such as predation risk, inter- and intra-specific competition, long-term survival and local adaptation. Attachment A to RMT (2010) provides a summary of reference information used develop species- and lifestage-specific water temperature index values. Furthermore, RMT(2010) states that *"The water temperature index values are not meant to be significance thresholds, but instead provide a mechanism by which to compare the suitability of the water temperature regimes associated with implementation of the Yuba Accord. The water temperature index values presented in Attachment A represent a gradation of potential effects, from reported optimal water temperatures increasing through the range of represented index values for each life stage"* (RMT 2010).

Additionally, RMT (2010) established temporal periodicities for anadromous salmonids of the lower Yuba River based on a review of previously conducted studies, as well as recent and currently ongoing data collection activities by the Yuba Accord Monitoring and Evaluation Program (M&E Program). Extensive data collection, monitoring and evaluation activities conducted by the Yuba Accord River Management Team (RMT) has resulted in lifestage periodicities which are presented in **Table 1** for steelhead, and spring-run and fall-run Chinook salmon specific to lower Yuba River. The potential effects of the SWRCB DFC scenario on spring-run and fall-run Chinook salmon, and steelhead are addressed in this technical memorandum based on the following species- and lifestage-specific periodicities and water temperature index values.

Table 1. Lifestage-Specific Periodicities for Steelhead, Spring-run Chinook salmon and Fall-run Chinook salmon in the lower Yuba River.

Lifestage	WTI	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
Steelhead																									
Adult Immigration & Holding	64°F	■	■	■	■	■	■									■	■	■	■	■	■	■	■	■	■
Spawning	57°F	■	■	■	■	■	■	■	■																
Embryo Incubation	57°F	■	■	■	■	■	■	■	■	■	■														
Juv. Rearing & Outmigration	65°F	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Yearling+ Smolt Emigration	55°F	■	■	■	■	■	■	■												■	■	■	■	■	■
Spring-Run Chinook Salmon																									
Adult Immigration & Holding	64°F							■	■	■	■	■	■	■	■	■	■								
Spawning	56°F																	■	■	■	■	■			
Embryo Incubation	56°F	■	■	■	■													■	■	■	■	■	■	■	■
Juv. Rearing & Outmigration	65°F	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Yearling+ Smolt Emigration	63°F	■	■	■	■	■	■	■	■	■												■	■	■	■
Fall-Run Chinook Salmon																									
Adult Immigration & Holding	64°F													■	■	■	■	■	■	■	■	■	■	■	
Spawning	56°F																			■	■	■	■	■	■
Embryo Incubation	56°F	■	■	■	■	■	■													■	■	■	■	■	■
Juv. Rearing & Outmigration	65°F	■	■	■	■	■	■	■	■	■	■	■	■	■	■									■	■

Steelhead

Water temperature index values for the adult immigration and adult holding lifestages are developed together, because it is difficult to determine the thermal regime that steelhead have been exposed to in the river prior to spawning, and in order to be sufficiently protective of pre-spawning fish, water temperatures that provide high adult survival and high egg viability must be available throughout the entire pre-spawning freshwater period.

A review of the literature summaries in Attachment A to RMT (2010) suggested a wide range of water temperature index values (52°F, 56°F, 70°F) for the steelhead immigration and holding lifestage. The RMT selected the water temperature index value of 56°F because this value represents a water temperature above which adverse effects to steelhead adult immigration and adult holding lifestages, and egg viability begin to arise. The RMT conducted an independent literature review to identify an intermediate value between 56°F and 70°F, which may impede upstream migration. Salinger and Anderson (2006) reported that over 93% of steelhead detections occurred in the 65.3-71.6°F, but that this was "probably above the temperature for optimal migration". Similar findings were reflected in a study conducted by Richter and Kolmes

(2005) suggesting that fall-run Chinook and steelhead encounter potentially stressful temperatures between 64.4-73.4°F. The RMT therefore identified the two water temperature index values of 56°F and 64°F for the evaluation of the steelhead immigration and holding lifestage.

Because the spawning and embryo incubation lifestage periodicities overlap and occur concurrently, water temperature index values are developed to evaluate both the spawning and embryo incubation lifestages. The water temperature index value of 54°F was selected by the RMT because studies conducted at or near 54.0°F report high survival and normal development, and that symptoms of thermal stress arise at or near 54.0°F. The RMT selected the water temperature index value of 57.0°F because relatively low mortality of incubating steelhead is reported to occur at 57.2°F, and a sharp decrease in survival was observed for *O. mykiss* embryos incubated above 57.2°F.

A water temperature index value was developed by the RMT to apply to the rearing (fry and juvenile) and juvenile outmigration lifestages. As previously described, some steelhead may rear in freshwater for up to three years before emigrating as yearling+ smolts, whereas other individuals move downstream shortly after emergence as post-emergent fry, or rear in the river for several months and move downstream as juveniles without exhibiting the ontogenetic characteristics of smolts. Presumably, these individuals continue to rear and grow in downstream areas (e.g., lower Feather River, Sacramento River, and Upper Delta) and undergo the smoltification process prior to entry into saline environments. Thus, fry and juvenile rearing occur concurrently with post-emergent fry and juvenile downstream movement and are assessed in this Technical Memorandum using the fry and juvenile rearing water temperature index values.

The water temperature index value of 65°F was selected by the RMT because: (1) it has been reported that this value is the upper limit preferred for growth and development of Sacramento and American River juvenile steelhead; (2) it is within the preferred water temperature range (i.e., 62.6°F to 68.0°F); (3) supports high growth rates of Nimbus strain juvenile steelhead; and (4) increasing levels of thermal stress to this life stage may reportedly occur above the 65°F water temperature index value.

Separate water temperature index values were developed by the RMT for the yearling+ smolt emigration lifestages for the purposes of this Technical Memorandum. Juvenile steelhead that exhibit extended rearing in the lower Yuba River are assumed to undergo the smoltification process and volitionally emigrate from the river as yearling+ individuals. Water temperature index values of 52°F and 55°F were selected to evaluate the steelhead yearling+ emigration lifestage, because most literature on water temperature effects on steelhead smolting suggest that water temperatures less than 52°F, or less than 55°F, are required for successful parr-smolt transformation.

Chinook Salmon

Development of water temperature index values separately for spring-run and fall-run Chinook salmon in this Technical Memorandum was considered. For example, McCullough (1999) states that spring-run Chinook salmon immigrate in spring and spawn in 3rd to 5th order streams and, therefore, face different migration and adult holding temperature regimes than do summer- or fall-run Chinook salmon, which spawn in streams of 5th order or greater. However, for this Technical Memorandum, water temperature index values for most lifestages of spring-run and fall-run Chinook salmon were not separated because: (1) both spring-run and fall-run Chinook salmon are restricted to spawning in the lower Yuba River below Englebright Dam, and are not spatially segregated in different order streams; (2) there is a paucity of literature specific to each lifestage for each run-type; (3) there is an insufficient amount of data available in the literature suggesting that Chinook salmon run-types respond to water temperatures differently; (4) the water temperature index values derived from the literature generally pertain to both spring-run and fall-run Chinook salmon; and (5) the temporal distribution of the various lifestages of spring-run and fall-run Chinook salmon overlap and the two runs are not readily distinguishable in the lower Yuba River. Where distinct water temperature index values are warranted for the same lifestage of spring-run and fall-run Chinook salmon, they are specified in this Technical Memorandum.

For Chinook salmon adult immigration and holding, the RMT selected the water temperature index values of 60°F and 64°F. The 60°F water temperature index value was selected because it is generally reported in the literature as the upper limit of the optimal range. The index value of 64°F was selected because the effects of thermal stress to pre-spawning adults are evident at water temperatures near 64°F, and latent embryonic abnormalities associated with water temperature exposure of pre-spawning adults to temperatures of 63.5°F to 66.2°F have been suggested.

A water temperature index value was developed by the RMT to evaluate both the spawning and embryo incubation lifestages for Chinook salmon because these lifestages are closely linked temporally, and studies describing how water temperature affects embryonic survival and development based on varying water temperature treatments on holding adults often report similar results to water temperature experiments conducted on fertilized eggs. A water temperature index value of 56°F was selected because water temperatures at or below this value: (1) promote maximum survival of Chinook salmon embryos; (2) alevin mortality is reportedly significantly higher when Chinook salmon embryos are incubated at water temperatures above 56°F; and (3) increasing levels of thermal stress to this lifestage may reportedly occur above 56°F.

A water temperature index value was developed by the RMT to apply to both the rearing (fry and juvenile) and juvenile downstream movement lifestages, for the reasons previously described regarding steelhead. Fry and juvenile rearing occur concurrently with post-emergent fry and juvenile downstream movement and are assessed in this Technical Memorandum using the fry and juvenile rearing water temperature index values. The water temperature index value of 65°F was selected by the RMT because, in addition to being specifically referenced in the literature, it represented an intermediate value between 64.0°F and 66.2°F, values which also are often referenced in the literature. Justification for the 65°F water temperature index value includes: (1) preferred for growth and development of fry and juvenile spring-run Chinook salmon in the Feather River; (2) disease outbreaks and mortalities increase at water temperatures above 65.0°F; (3) optimum temperature for growth appears to occur at about 66.2°F; (4) optimal range for Chinook salmon survival and growth from 53.0°F to 64.0°F; and (5) survival of Central Valley juvenile Chinook salmon declines at temperatures greater than 64.4°F.

Juvenile Chinook salmon that exhibit extended rearing in the lower Yuba River are assumed to undergo the smoltification process and volitionally emigrate from the river as yearling+ individuals. A water temperature index value of 63°F was selected by the RMT to evaluate the spring-run Chinook yearling+ emigration lifestage, because water temperatures at or below this value allow for successful transformation to the smolt stage, and water temperatures above this value may result in impaired smoltification indices, inhibition of smolt development, and decreased survival and successful smoltification of juvenile spring-run Chinook salmon.

3 POTENTIAL IMPACTS OF IMPLEMENTATION OF THE DFC TO ANADROMOUS SALMONIDS IN THE LOWER YUBA RIVER

3.1. POTENTIAL FLOW RELATED IMPACTS

The amount of water stored in New Bullards Bar Reservoir at the end of September is one indicator for evaluating the potential effects of implementation of the SWRCB DFC scenario because it is used in the calculation of the North Yuba Index (NYI). The NYI is a metric of water availability, partly based on end-of-September New Bullards Bar Reservoir storage, presently used to determine minimum instream flow requirements on an annual basis for the benefit of aquatic resources of the lower Yuba River.

Reductions in New Bullards Bar Reservoir end-of-September storage have the potential to reduce the following year's minimum instream flow requirements by altering the NYI value. Implementation of the SWRCB DFC scenario would result in 7 years in the 29-year simulation (or about a 24 percent increase) of lower required minimum flows in the lower Yuba River (Figure 3.1-3 in Grinnell 2012). Results of this analysis also indicate that reduced end of September storage in New Bullards Bar Reservoir would result in three conference years (i.e., 10 percent probability) under the SWRCB DFC scenario, relative to one conference year under the Baseline Condition. Conference years were estimated to occur with about a 1-in-100 year probability under the Yuba Accord. In consideration that the Technical Team's emphasis on implementation of the Yuba Accord was centered on maximizing the probability of occurrence of the higher magnitude minimum instream flow schedules, and the avoidance of conference year conditions, implementation of the SWRCB DFC scenario would represent significant flow-related impacts to the aquatic resources of the lower Yuba River.

3.2. POTENTIAL WATER TEMPERATURE RELATED IMPACTS

The modeling results of this analysis also indicate that implementation of the SWRCB DFC scenario would result in New Bullards Bar Reservoir storage dropping to a depleted state on five occasions and approaches a depleted state a sixth time during the 29-year simulation period, relative to one instance under the Baseline Condition (Figure 3.1-2 in Grinnell 2012). The "depleted state" of storage in New Bullards Bar Reservoir is characterized by a storage volume equal to minimum pool requirements (234,000 acre-feet). Thus, the cold-water pool in New Bullards Bar Reservoir would be depleted in half of all dry and critical years (5 of 10) under the SWRCB DFC scenario. Due to the frequency of California droughts, New Bullards Bar Reservoir storage would remain at a depleted state 65 percent of the time during the more than 5-year span extending from the fall of 1987 to 1993 (Grinnell 2012). In comparison, the historic data indicates that the cold-water pool of New Bullards Bar Reservoir has not reached a depleted state at any time during the operations period between 1970 through present (DWR and PG&E 2010). Furthermore, this period includes the most extreme critically dry year on record (1977).

The modeling results of this analysis further demonstrate that the temperature of water released from New Bullards Bar Reservoir at the Colgate Powerhouse under the Baseline Condition ranges between 46 and 52 °F over the 29-year period of evaluation, with the exception of the extreme drought year of 1977 when water temperatures approached 59 °F. By contrast, water temperatures released from the Colgate Powerhouse under the SWRCB DFC scenario depleted pool condition ranged between 46 and 71 °F. Increases in Colgate Powerhouse release water temperatures due to the SWRCB DFC scenario were generally between 2 to 12 °F during June through September for eight of the 29 years evaluated (about 28 percent) relative to the Baseline Condition. Additionally, the eight years when the SWRCB DFC scenario resulted in warmer water temperatures relative to the Baseline Condition generally coincided with dry and critical water year types (Grinnell 2012).

As previously described, the cold-water releases from New Bullards Bar Reservoir influence the temperature of water released from Englebright Reservoir into the lower Yuba River, and downstream to the confluence with the Feather River near Marysville. Additionally, because higher release water temperatures under the SWRCB DFC scenario relative to the Baseline Condition also coincide with substantially lower flows during the summer and fall months of the driest years, water temperatures would increase at a higher rate and to a greater magnitude in a downstream direction. Because a daily temperature model of the lower Yuba River was not available for this evaluation, the effects of implementing the SWRCB DFC scenario on water temperatures in the lower Yuba River were assessed using modeled Colgate Powerhouse release water temperatures as a minimum representation of potential impact to anadromous salmonids. Furthermore, the known relationship between water discharge and water temperature suggests that warmer water temperatures are anticipated to occur during low flow conditions and generally during dry and critically dry water year types, as well as during summer months. Therefore, as an indication of potential impact of the SWRCB DFC scenario to anadromous salmonids of the lower Yuba River, water temperature monitoring data measured at Colgate Powerhouse and at the Marysville gage in the lower Yuba River under low flow conditions were evaluated in order to assess the potential effects of implementation of the SWRCB DFC on water temperatures in the lower Yuba River.

Although interannually variable, historic water temperatures measured at Colgate Powerhouse and in the lower Yuba River are indicative of the range of water temperatures expected to occur under implementation of the SWRCB DFC, during comparatively similar flow conditions. Beginning in September 1993, the low-level outlet at New Bullards Bar Dam has been exclusively used for all controlled releases which has improved year-round water temperature conditions for anadromous salmonids in the lower Yuba River by providing sufficient cold-water releases from New Bullards Bar Reservoir (RMT 2010). Although YCWA formally began utilizing the lower level outlet of New Bullards Bar Dam exclusively in 1993, the temperature records suggest that the lower level outlet was used in 1992 as well (S. Grinnell pers. comm. 2012).

During 1992, YCWA periodically took reservoir temperature profile readings as well as readings at various locations on the lower Yuba River and also maintained temperature recordings for the powerhouse penstocks (**Figure 2**). During this critical year, flows were low during July and August such that releases were made in compliance with the FERC license required minimum instream flow of 70 cfs at the Colgate Powerhouse, which was the controlling minimum instream flow for that time. Historic flow data indicates that flows observed at Marysville during the 1992 July and August months were less than 100 cfs. Water temperatures measured during 1992 ranged between 46 to 49 °F during summer month at the Colgate Powerhouse, and between 70 to 73 °F at Marysville. Based on the 1992 monitoring data, the average water temperature increased in the downstream direction between the Colgate Powerhouse and Marysville Gage by approximately 24 °F during July and August.

July 1990 is an example of water temperatures that may occur under low flow conditions between Colgate Powerhouse and Marysville because water released from the upper level outlet at New Bullards Bar Dam resulted in approximately 275 cfs at Marysville. During July 1990, water temperatures were approximately 60 °F at the Colgate Powerhouse and approximately 77°F at the Marysville Gage. Therefore, the range of warming that would be expected to occur between the Colgate Powerhouse downstream to the Marysville Gage in the lower Yuba River is approximately 17 °F under these types of conditions.

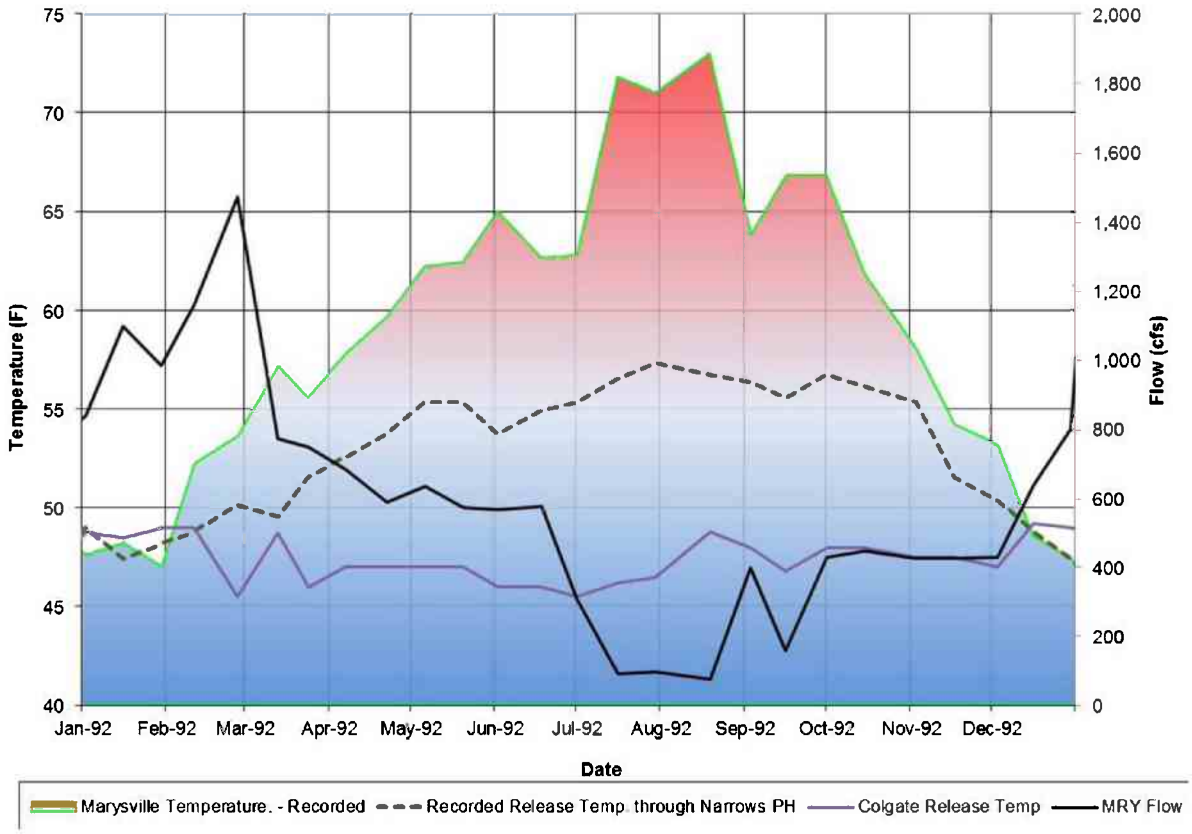

Figure 2. Powerhouse release temperatures, Yuba River Water temperatures and flow at Marysville for 1992 (Grinnell 2012).

During the eight years when the SWRCB DFC scenario resulted in warmer water temperatures released from Colgate Powerhouse, four of these years would result in summer (July and August) flows at the Marysville Gage ranging between about 70 and 150 cfs, and the other four years would result in summer flows of about 400 cfs. Applying the rate of warming between Colgate Powerhouse and the Marysville Gage observed in 1992 to the first group of four years, and the rate observed in 1990 to the second group of four years provides a rough indication of water temperatures during the summer at the Marysville Gage.

During these same eight years, flows at the Marysville Gage under the Baseline Condition generally range between 1,100 to 1,250 cfs during the summer (July and August) for four of these years, an additional year at about 650 cfs, two years would result in summer flows ranging between about 250 to 350 cfs, and one year of less than 100 cfs. Monitoring conducted during the summer of 2007, 2008 and 2009 when average flows at the Marysville Gage were about 737 cfs, 590 cfs and 1,725 cfs respectively, resulted in water temperatures at the Marysville Gage that remained at or below 64 °F. Applying these monitoring results to the group of five years with flows ranging from about 650 to 1,250 cfs, the rate of warming between Colgate Powerhouse and the Marysville Gage observed in 1990 to the group of two years, and the rate observed in

1992 to the one year provides an indication of water temperatures during the summer at the Marysville Gage under the Baseline Conditions.

During the summer months (July and August) the following lifestages and corresponding water temperature index values would apply:

- Steelhead, spring-run Chinook salmon, and fall-run Chinook salmon adult immigration and holding (64°F)
- Steelhead, spring-run Chinook salmon, and fall-run Chinook salmon juvenile rearing and downstream movement (65°F)

Estimation of water temperatures at the Marysville Gage indicate that the water temperature suitability value for adult immigration and holding and juvenile rearing and downstream movement would be exceeded during 8 years under the SWRCB DFC, compared to 3 years under the Baseline Condition.

4 CONCLUSIONS AND RECOMMENDATIONS

Taking into account the entire suite of considerations presented in this Technical Memorandum, it is concluded that implementation of the SWRCB DFC would result in potentially significant flow and water temperature–related impacts to anadromous salmonids in the lower Yuba River, specifically during summer months of dry and critical water year types. Further, it is recommended that this Technical Memorandum be supplemented by incorporating additional data and information by the application of a daily time-step water temperature model, when such a model becomes available, to provide greater resolution and to further evaluate potential impacts associated with implementation of the SWRCB DFC scenario.

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APPENDIX B - THE YUBA RIVER WATERSHED, FACILITIES, AND CURRENT OPERATIONS

This appendix describes the Yuba River Watershed, the YRDP and other facilities, and current operations of the YRDP. A map of the Yuba River Watershed and major facilities is presented in **Figure 1**.

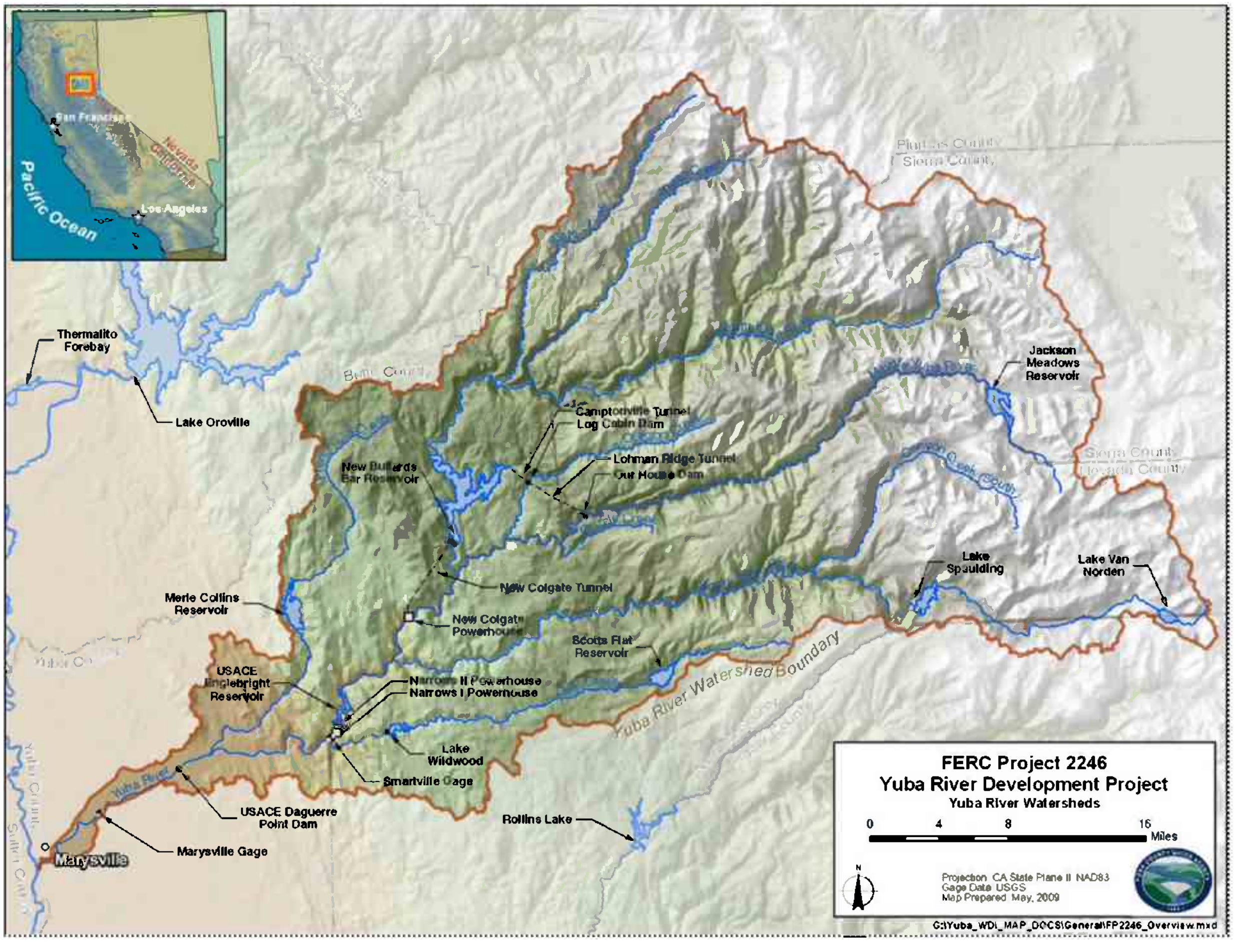


Figure 1. Map of the Yuba River Watershed and Major Facilities.

1. THE YUBA RIVER WATERSHED

The Yuba River has an average annual unimpaired runoff of about 2.3 million acre-feet, representing about 11 percent of the average annual Sacramento Valley unimpaired outflow to the Delta. **Figure 2** shows the average monthly unimpaired Sacramento Valley outflow and Yuba River flow at Smartsville for the period extending from 1921 through 2003; the Yuba River comprises a small percentage of the Sacramento River flow, and the relative contribution of the Yuba River to the Sacramento River flow varies significantly between months of the year[1]. The

[1] California Department of Water Resources "California Central Valley Unimpaired Flow Data", Fourth ed. 2007

SWRCB Report states, "Inflows should generally be provided from tributaries to the Delta watershed in proportion to their contribution to unimpaired flow unless otherwise indicated." Literally interpreted, this statement means that if the SWRCB DFC, as presented in the SWRCB Report, were implemented, outflow from the Yuba River would need to conform to the same criteria: 75 percent of unimpaired flow on the Sacramento River would mean 75 percent unimpaired outflow from the Yuba River.

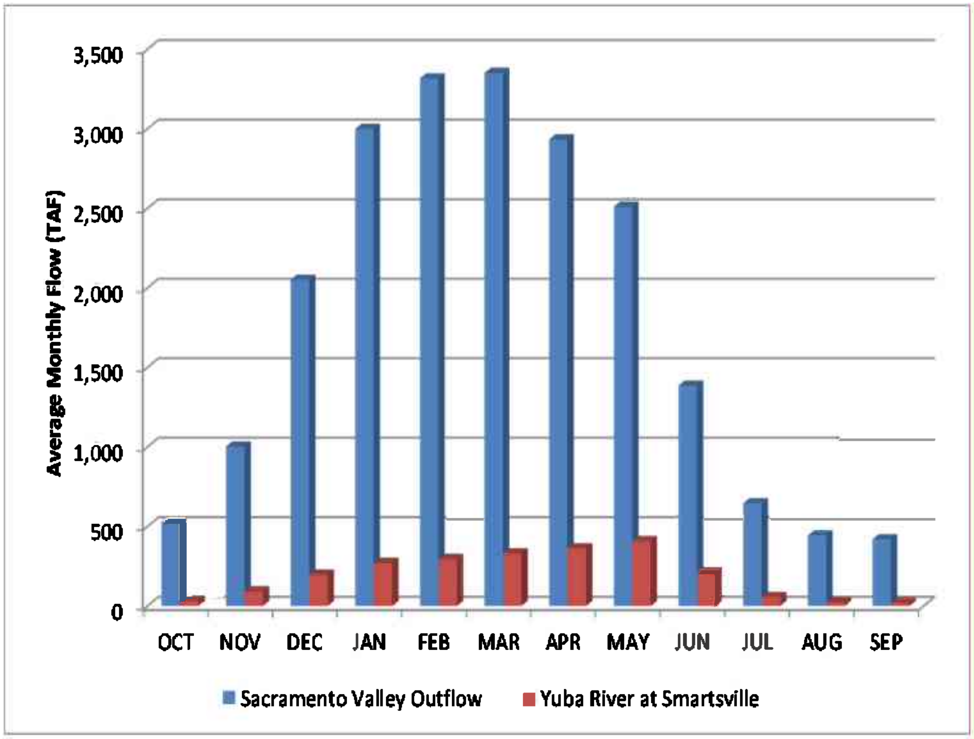


Figure 2. Monthly Average Unimpaired Sacramento River Outflow and Yuba River Flow at Smartsville for the Period Extending from 1921 through 2003.

1.1 NORTH YUBA RIVER

The upper extent of the North Yuba River is at Yuba Pass (elevation 6,701 feet above mean sea level) near California State Highway 49 in Sierra County. The river flows parallel to the highway as far as Downieville, where it diverges from the Highway and flows westward into New Bullards Bar Reservoir. The North Yuba River terminates at its confluence with the Middle Yuba River, located, approximately 2 miles downstream from New Bullards Bar Dam, at which point the combined flow of the two rivers becomes the Yuba River. The area of the North Yuba River watershed is approximately 491 square miles, and includes portions of Yuba, Sierra, and Plumas counties. The North Yuba River is predominantly a snowmelt-driven stream, with peak flows occurring during March through May. On a long-term average basis, months with the lowest North Yuba River flow occur during August through October. The average annual historical runoff from the North Yuba River contributes approximately 55 percent of the annual inflow to Englebright Reservoir; but unimpaired North Yuba River flow is only 44 percent of unimpaired Yuba River flow at Smartsville. This difference is due to out-of-basin diversions of water from the Middle and South Yuba rivers upstream of Englebright Reservoir.

1.2 MIDDLE YUBA RIVER

Flows in the Middle Yuba River originate from snowmelt and rainfall runoff above the main upper watershed impoundment, Jackson Meadows Reservoir, which has a dam crest elevation of 6,044.5 feet above mean sea level, and is located near Sierra City in Sierra County. Most of the upper reaches of the Middle Yuba River are contained in narrow, steep canyons until the river reaches the 75-foot-high Our House Dam, the upper extent of the YRDP, located southwest of Camptonville near the Sierra/Nevada County line. Approximately 12 miles below Our House Dam, the Middle Yuba River joins the North Yuba River.

The Middle Yuba River watershed, including Oregon Creek, covers approximately 210 square miles, with elevations ranging from 1,120 feet above mean sea level (above mean sea level) to 7,200 feet above mean sea level. There are several developments on the upper Middle Yuba River, some of which are part of the Nevada Irrigation District's (NID) Yuba-Bear Project (Federal Energy Regulatory Commission Project 2266). A portion of Middle Yuba River flows are diverted into the South Yuba River basin by the Milton Diversion Dam through the Yuba-Bear Project's Milton-Bowman Tunnel. The Yuba-Bear Project has minimum instream flow requirements below the Milton Diversion Dam. Releases from Milton Diversion Dam and runoff from the subbasin area below the dam flow to Our House Dam, which has a crest elevation of 2,030 feet above mean sea level. Inflow at the Our House Dam is partially diverted to Oregon Creek through the Lohman Ridge Tunnel. Oregon Creek joins the Middle Yuba River approximately 8.5 miles below Our House Dam, and the combined flow joins with the North Yuba River below New Bullards Bar Reservoir to form the Yuba River. Approximately 23 square miles of the Middle Yuba River watershed lies below Our House Dam on the Middle Yuba River. On a long-term average basis, impaired runoff from the Middle Yuba River contributes approximately 19 percent of the inflow to Englebright Reservoir; and unimpaired Middle Yuba River flows are approximately 18 percent of unimpaired Yuba River flow at Smartsville.

1.3 SOUTH YUBA RIVER

The headwaters of the South Yuba River begin at an elevation of 9,000 feet above mean sea level in Placer County near Castle Peak and Donner Lake. The South Yuba River is subject to multiple upstream developments, primarily NID's Yuba Bear Project, and Pacific Gas and Electric's (PG&E) Drum-Spaulding Project (FERC Project 2310). Flow from the Middle Yuba River is diverted to the South Yuba River at Lake Spaulding via the Bowman-Spaulding Tunnel, and flow from the South Yuba is diverted into the Bear and American river basins via the Drum Canal and South Yuba Canal. Remaining South Yuba River flow joins the Yuba River at Englebright Reservoir. Impaired South Yuba River inflows account for approximately 21 percent of the long-term average inflow to Englebright Reservoir; and unimpaired South Yuba River flows are approximately 34 percent of unimpaired Yuba River flow at Smartsville.

1.4 YUBA RIVER

The Yuba River begins at the confluence of the North and Middle Yuba rivers, approximately 16 miles upstream from the U.S. Army Corps of Engineers (USACE) Englebright Dam, at an elevation of approximately 1,124 feet above mean sea level. The lower Yuba River then extends approximately 24 miles from Englebright Dam to confluence of the Yuba and Feather rivers near Marysville, California. The Yuba River sub-basin covers approximately 95 square miles. Flows on the lower Yuba River have been monitored since October 1, 1941 at the Smartsville Gage (USGS 11418000), located just downstream of Englebright Dam, and since October 1, 1963 at the Marysville Gage (USGS 11421000), located approximately six miles upstream from the confluence of the lower Yuba and Feather rivers. Total average annual impaired flow at the Smartsville Gage is approximately 1,800 thousand acre-feet (TAF), and the average annual unimpaired flow at Smartsville is estimated to be approximately 2,300 TAF.

2. THE YUBA RIVER DEVELOPMENT PROJECT AND OTHER FACILITIES

The YRDP (FERC Project No. 2266), shown in **Figure 3**, constructed in the mid-1960s and put into service in the spring of 1970, ranges in elevation from about 300 feet to 2,050 feet above mean sea level. The YRDP includes:

- one dam and associated storage reservoir – New Bullards Bar Dam and Reservoir
- two diversion dams – Our House Dam and Log Cabin Dam
- two diversion tunnels – Lohman Ridge and Camptonville
- two power tunnels – New Colgate and Narrows 2
- one penstock – New Colgate
- three powerhouses – New Colgate, New Bullards Bar Minimum Flow Powerhouse, and Narrows 2

The YRDP does not include the USACE's Englebright Dam and Reservoir or USACE's Daguerre Point Dam. The YRDP also does not include the Narrows 1 Powerhouse, which is located near Englebright Dam and is part of PG&E Narrows 1 Project (FERC Project No. 1403). However, these USACE and PG&E facilities affect Yuba River flows along with operations of the YRDP, so these facilities are included in this hydrologic analysis of the Yuba River system.

2.1 NEW BULLARDS BAR DAM AND RESERVOIR

New Bullards Bar Dam is a 1,110-foot-radius, double-curvature, concrete arch dam located on the north yuba river about 2.3 miles upstream of its confluence with the middle yuba river. The dam is 645 feet high with a maximum elevation of 1,965 feet above mean sea level. The dam includes one low-level outlet - a 72 inch hollow jet valve (invert elevation 1,395 feet above mean sea level) with a maximum design capacity of about 3,500 cfs at full reservoir pool, and an actual capacity of 1,250 cfs (i.e., the actual release capacity is limited to 1,250 cfs because of valve vibrations at higher release rates).

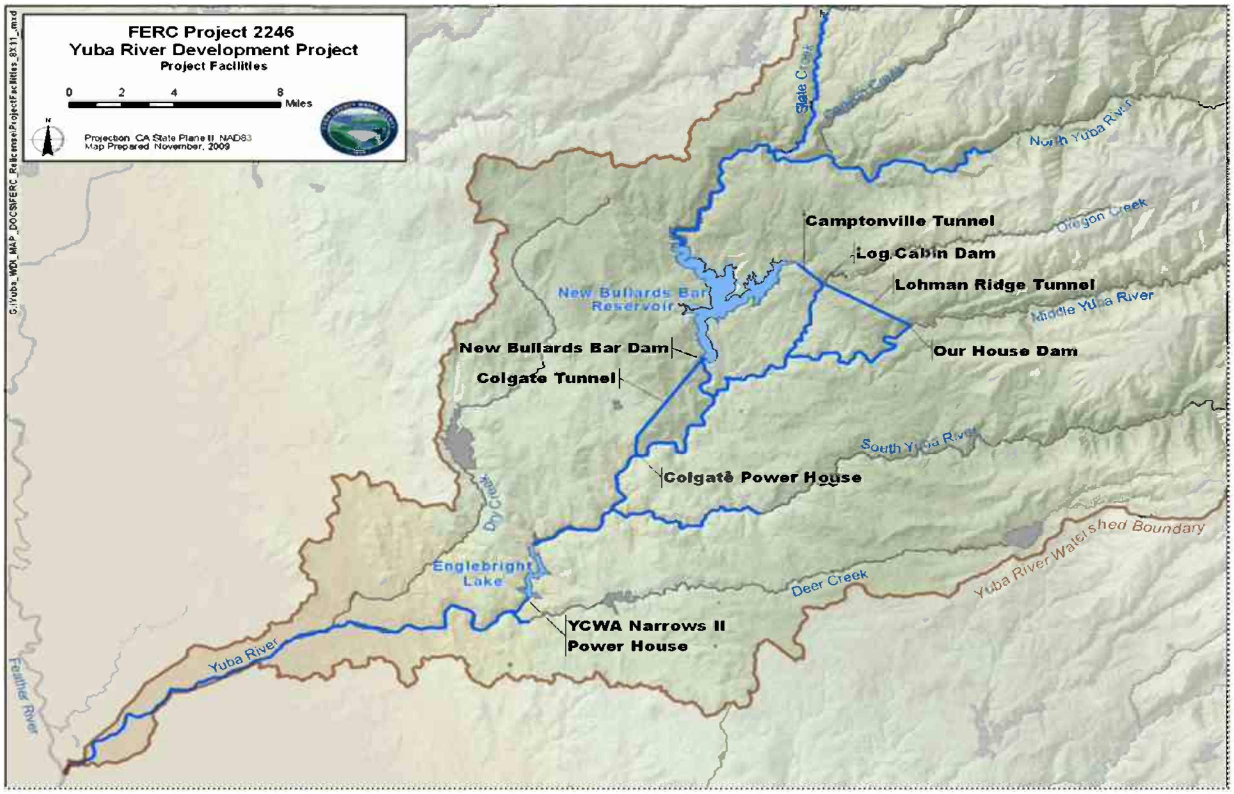


Figure 3. Yuba River Development Project.

New Bullards Bar Reservoir is the principal storage facility of the YRDP. The North Yuba River inflow to New Bullards Bar Reservoir is augmented by diversions from the Middle Yuba River to Oregon Creek through the Lohman Ridge Tunnel, and by diversions from Oregon Creek into the reservoir through the Camptonville Tunnel. The average total inflow to New Bullards Bar Reservoir from the North Yuba River and diversions from the Middle Yuba River and Oregon Creek is about 1.2 million acre-feet per year.

New Bullards Bar Reservoir is deep, and thermally stratified, and has a retention time of about 6 months. The reservoir is tri-forked shaped. The narrow center arm, which is the longest (about 13 miles long) of the three arms, extends up the North Yuba River to just upstream from the Slate Creek confluence. The slightly wider northeast arm extends upstream about 4 miles, and is formed primarily by Willow and Badger creeks. The northwest arm, the shortest (i.e. about 1 mile long) of the three arms of the reservoir, is formed by Little Oregon and Burnt Bridge creeks. The portion of reservoir north of New Bullards Bar Dam near Garden Point is the widest portion of the reservoir (about 2 miles wide). Most of the land surrounding New Bullards Bar Reservoir is primitive, with no roads or residential communities.

The reservoir has a total storage capacity of 966,103 acre-feet with a minimum operating level of 234,000 acre-feet, leaving 732,103 acre-feet of regulated capacity. YCWA typically operates New Bullards Bar Dam and Reservoir by capturing winter and spring runoff from rain and snowmelt. Consequently, New Bullards Bar Reservoir reaches its peak storage at the end of the spring runoff season, and then is gradually drawn down as water is released into the North Yuba River. Water is released through the New Bullards Bar Minimum Flow Powerhouse (located at the base of the dam), and through the New Colgate Power Tunnel and New Colgate Powerhouse into the North Yuba River. The reservoir usually reaches its lowest elevation in mid-winter. The annual drawdown in normal water years is about 90 feet. The reservoir does not undergo significant daily changes in elevation.

New Bullards Bar Reservoir is used to provide irrigation water supply to about 90,000 acres of farmland in western Yuba County. Releases of water from storage are made during the spring and summer to provide flows that are diverted downstream at Daguerre Point Dam at river mile 12.0 on the lower Yuba River. Water is released from storage in the fall for diversion at Daguerre Point Dam for rice stubble decomposition and waterfowl habitat.

New Bullards Bar Reservoir also is the main flood management facility for the lower Yuba River area. About 23 percent (170,000 acre-feet) of the usable capacity of the reservoir is held in reserve from October through May for flood management purposes.

In addition to providing flood management, power generation, and downstream water supply, YCWA pumps water directly from New Bullards Bar Reservoir to supply water to the Cottage Creek Water Treatment Plant for domestic and recreation uses adjacent to the reservoir. This pumping averages approximately 6 acre-feet per year. This relatively minimal amount of pumping does not affect YRDP operations.

New Bullards Bar Reservoir and vicinity also are used for public recreation, with recreational facilities consisting of 96 campsites, 9 picnic sites, 1 group picnic shelter, 2 boat launch ramps, 1 private marina concession, 5 parking lots, and several biking and hiking trails.

2.2 NEW COLGATE POWERHOUSE

The New Colgate Powerhouse is an above ground, steel-reinforced, concrete powerhouse located adjacent to the North Yuba River. The powerhouse contains two Voith Siemens Pelton-type turbines with a total capacity of 340 megawatts (MW) under a design head of 1,306 feet and a rated flow of 3,430 cfs. The powerhouse receives water from the New Colgate Power Tunnel and Penstock. The New Colgate Power Tunnel and Penstock is 5.2 miles long and composed of four different types of conveyance structures including an unlined horseshoe tunnel 26 feet square, a lined horseshoe tunnel 20 feet wide and 14.5 feet high, a lined circular tunnel 14 feet in diameter, and 2,809 feet of steel penstock with a diameter ranging from 9 feet to 14.5 feet. The tunnel and penstock have a maximum flow capacity of 3,500 cfs.

2.3 ENGLEBRIGHT DAM AND RESERVOIR

Englebright Dam and Reservoir were constructed in 1941 by the USACE to capture sediment resulting from upstream hydraulic mining activities. The reservoir is situated downstream from New Bullards Bar Dam, and receives inflow from the North, Middle, and South Yuba rivers. The average annual inflow to Englebright Reservoir, excluding releases from New Bullards Bar Reservoir, is approximately 400 TAF. Englebright Reservoir has a total storage capacity of approximately 70 TAF, but storage levels normally fluctuate by a maximum of 8,500 acre-feet each year. Englebright Reservoir is used extensively for recreation.

Englebright Dam has no low-level outlet. Water from Englebright Reservoir is either spilled over the top of the dam or released for power generation at the Narrows 1 and Narrows 2 powerhouses.

2.4 NARROWS 1 AND 2 POWERHOUSES

Narrows 1 Powerhouse, owned by PG&E, is a 12 MW facility, with a discharge capacity of approximately 730 cfs and a bypass flow capacity (when the generator is not operating) of 540 cfs. Narrows 2, part of the YRDP, is a 50 MW facility, with a discharge capacity of approximately 3,400 cfs and a bypass flow capacity of 3,000 cfs. Both the Narrows 1 and Narrows 2 facilities have intake structures that draw water from Englebright Reservoir. The Narrows 1 Power plant and outfall are located approximately 1,500 feet downstream of the Narrows 2 facility on the south bank of the river. The Narrows 2 PowerplantPower plant and outfall are located approximately 400 feet downstream of Englebright Dam on the north bank of the lower Yuba River.

From 1941 through about 1970, flows greater than PG&E Narrows 1 facility's maximum flow capacity of about 740 cfs spilled over Englebright Dam. Since about 1970, operation of the Narrows 2 facility by YCWA has greatly increased the capability for controlling flows from Englebright Reservoir. YCWA and PG&E coordinate the operations of Narrows 1 and 2 for hydropower efficiency and to maintain relatively constant flows in the lower Yuba River. The Narrows 1 Power plant typically is used for low-flow reservoir releases, or to supplement the Narrows 2 Power plant capacity during high flow reservoir releases. The Narrows 1 Power plant is usually operated when total releases from Englebright Dam are about 730 cfs or less. When releases range from about 730 to 2,560 cfs, the Narrows 2 Powerplant normally is operated. When releases exceed about 2,560 cfs, both powerplants normally operate. The combined release capacity of Narrows 1 and Narrows 2 is about 4,200 cfs (YCWA 2003).

Annual maintenance requires the Narrows 2 Powerhouse to be shut down for a 2 to 3 week period, or longer if major maintenance is performed. Maintenance is typically scheduled for the beginning of September, or during the winter months.

3. CURRENT OPERATIONS

The YRDP is operated for many physical, regulatory, and mission objective constraints and priorities. The primary downstream controls for lower Yuba River flows are: minimum instream flow requirements at the Smartsville Gage for a portion of the year; minimum instream flow requirements at the Marysville Gage; and Daguerre Point Dam irrigation diversion demands. Because the minimum instream flow requirements at the Marysville Gage extend over the entire year, and because of the seasonally variable diversion demands at Daguerre Point Dam, total flow releases exceed the Smartsville minimum instream flow requirements for all months except January through March. For periods when the YRDP is operating to meet downstream controls, and not for management of storage, instream flow at the Marysville Gage serves as a surrogate for required Yuba River outflow, because there are no significant diversions from the Yuba River below this point.

The operations of New Bullards Bar Reservoir are conditioned on meeting downstream demands, managing storage levels to desired or required storage levels throughout the water year, and power generation. Management of flood flows is the primary constraint on operations. Downstream demands are the primary non-flood constraint on releases, and the combination of instream flows and diversion deliveries control release decisions almost exclusively in drier years.

3.1 FLOOD MANAGEMENT OPERATIONS

New Bullards Bar Reservoir must be operated from September 16 to May 31 each year to comply with Part 208 "Flood Control Regulations, New Bullards Bar Dam and Reservoir, North Yuba River, California," pursuant to Section 7 of the Flood Control Act of 1944 (58 Stat. 890). Under the contract between the United States and YCWA that was entered into on May 9, 1966, YCWA agreed to reserve in New Bullards Bar Reservoir 170,000 acre-feet of storage space for flood control in accordance with rules and regulations enumerated in Appendix A of the "Report on Reservoir Regulation for Flood Control" (USACE June 1972). The seasonal flood storage space allocation schedule is presented in **Table 1**.

Table 1. New Bullards Bar Reservoir Flood Storage Space Allocation.

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Storage Allocation (TAF)	170	170	170	170	170	170	70	0	0	0	0	56

TAF = Thousand acre-feet

In addition to reservation of flood control space in New Bullards Bar Reservoir, the flood control regulations include rules governing ramping rates, as well as target maximum flows in the lower Yuba River and the lower Feather River downstream of the confluence with the lower Yuba River.

YCWA also coordinates operations with operations of PG&E's Narrows 1 Powerhouse at Englebright Dam to use storage in Englebright Reservoir to capture winter storm freshets and reduce storm flows on the lower Yuba River. This operation is accomplished by evacuating storage space in Englebright Reservoir in anticipation of storm peak flows.

3.2 FERC REQUIREMENTS

FERC originally issued a license under the Federal Power Act for the YRDP on May 16, 1963 (FERC 1963). On May 6, 1966, FERC issued an order amending this license. The amended license contains release and instream flow requirements similar to those in the 1965 YCWA/California Department of Fish and Game (CDFG) agreement. YCWA is obligated to operate in such a way as to meet minimum instream flows throughout the year below Log Cabin Diversion Dam, Our House Diversion Dam, New Bullards Bar Dam, Englebright Dam, and Daguerre Point Dam. The FERC flow criteria have been mostly superseded by the Yuba Accord instream flow requirements on the lower Yuba River downstream of Englebright Dam. The instream flow requirements for Log Cabin Diversion Dam, Our House Diversion Dam and New Bullards Bar Dam range from 5 to 30 cfs, depending upon location and time of year.

3.2.1 Flow Fluctuation and Reductions (Ramping Criteria)

YCWA operates the YRDP to meet specific criteria for flow fluctuations in the lower Yuba River as measured at the Smartsville Gage. Flow fluctuation criteria are highly relevant to the SWRCB DFC, because the flow fluctuation criteria can require substantially higher releases after a flow event than what the SWRCB DFC alone would require.

Flow fluctuation criteria are specified in the 1966 FERC License and in SWRCB Revised Decision 1644 (RD-1644). On November 22, 2005, FERC approved an amendment to YCWA's license for the YRDP that contains flow fluctuation criteria similar to those specified in RD-1644. The 2005 amended license is the controlling requirement for operation of the YRDP. The amended license specifies that, with the exception of emergencies, releases for flood control operations, bypasses of uncontrolled inflows into Englebright Reservoir, or uncontrolled spills, the YRDP be operated according to the following requirements:

- Project releases or bypasses that increase stream flow downstream from Englebright Dam shall not exceed a rate of change of more than 500 cfs per hour.
- Project releases or bypasses that reduce stream flow downstream of Englebright Dam shall be gradual and, over the course of any 24-hour period, shall not be reduced below 70 percent of the prior day's average flow release or bypass flow.
- Once the daily project release or bypass level is achieved, fluctuations in the stream flow level downstream of Englebright Dam due to changes in project operations shall not vary up or down by more than 15 percent of the average daily flow.
- During the period from September 15 to October 31, the licensee shall not reduce the flow downstream of Englebright Dam to less than 55 percent of the maximum five-day average release or bypass level that has occurred during that September 15 to October 31 period, or the minimum stream flow requirement that would otherwise apply, whichever is greater.
- During the period from November 1 to March 31, the licensee shall not reduce the flow downstream of Englebright Dam to less than the minimum stream flow release or bypass established under the preceding paragraph; 65 percent of the maximum five-day average flow release or bypass that has occurred during that November 1 to March 31 period; or the minimum stream flow requirement that would otherwise apply, whichever is greater.

3.3 YUBA ACCORD – RESERVOIR STORAGE AND INSTREAM FLOW REQUIREMENTS

The Yuba Accord incudes the primary opertional requirements for the lower Yuba River, and includes both a specific set of flow schedules for the lower Yuba River, and New Bullards Bar Reservoir storage operation targets.

3.3.1 New Bullards Bar Reservoir Storage

Storage targets are used when modeling New Bullards Bar Reservoir as a surrogate for the complex assessment of watershed state, forecasted inflows, and probabilistic conditions that actually are used for release decisions to manage storage. The model uses a target line and target zone boundaries, referred to as the upper target line and lower target line, to determine release decisions when storage levels are high enough to warrant releases higher than the flow needed to meet downstream demands. The single-most important storage target for New Bullards Bar Reservoir is the end-of-September carryover storage required for subsequent year drought protection. This is the dry condition storage target. The upper limit target for the end of September is 650,000 acre-feet. This target ensures that a stored water transfer of 60,000 acre-feet to the CALFED Environmental Water Account is completed each year in compliance with the Yuba Accord Water Purchase Agreement.

Under the Yuba Accord, New Bullards Bar Reservoir is operated to meet minimum carryover storage requirements (end-of-September storage) designed to ensure that instream flow requirements and anticipated surface water deliveries to YCWA member units will be met during the next year. The carryover storage requirement is a drought protection measure. New Bullards Bar Reservoir carryover storage is used to make up the difference between the available surface water supply and system demands (diversion demands, instream flow requirements, and system operational losses) under dry conditions. For modeling purposes, the determination of the yearly carryover storage requirement is based on several factors: the drought protection level (return period); Member Unit water demands; instream flow requirements; minimum percentage delivery during the next year; and forecasted unimpaired flows. The drought protection level is designed to provide full instream flow requirements and 50 percent of diversion requirements during the following water year, if that water year were to have the specified return period (assumed for current modeling studies to be 1 in 100 years, that is, if the next year is a 1-in-100 driest year). The 50 percent delivery corresponds approximately to no deliveries of contractual supplemental water, a 50 percent reduction in deliveries of contractual base project water, and full deliveries of all pre-1914 water rights settlement water.

3.3.2 North Yuba Index and Flow Schedules

The Yuba Accord includes a specific set of flow schedules, shown in **Table 2,** for the lower Yuba River. The flow schedule in effect at any particular time is determined by the North Yuba Index (NYI), a hydrologic index that was developed as a part of the Yuba Accord. The NYI is a factor of both New Bullards Bar Reservoir end-of-September storage and inflow to New Bullards Bar Reservoir. Therefore, each year's index and associated flow schedule are affected by the previous water year inflows and releases from New Bullards Bar Reservoir. This approach to instream flow allocation was determined to be the most accurate at allocating as much water as possible to instream flows, without causing unnecessary impacts to water supply or end-of-year storage, due to inaccuracies of water year type determinations.

Table 2. Lower Yuba River Accord Flow Schedules.

Sch.	Oct		Nov	Dec	Jan	Feb	Mar	Apr		May		Jun		Jul	Aug	Sep	Total Annual Vol. (AF)
	1-15	16-30	1-30	1-31	1-31	1-29	1-31	1-15	16-30	1-15	16-31	1-15	16-30	1-31	1-31	1-30	
MARYSVILLE GAGE[1] (cfs)																	
1	500	500	500	500	500	500	700	1,000	1,000	2,000	2,000	1,500	1,500	700	600	500	574,200
2	500	500	500	500	500	500	700	700	800	1,000	1,00	800	500	500	500	500	429,066
3	500	500	500	500	500	500	500	700	700	900	900	500	500	500	500	500	398,722
4	400	400	500	500	500	500	500	600	900	900	600	400	400	400	400	400	361,944
5	400	400	500	500	500	500	500	500	600	600	400	400	400	400	400	400	334,818
6[2]	350	350	350	350	350	350	350	350	500	500	400	300	150	150	150	350	232,155
SMARTVILLE GAGE[1] (cfs)																	
A[3]	700	700	700	700	700	700	700	700	----	----	----	----	----	----	----	700	----
B[4]	600	600	600	550	550	550	550	600	----	----	----	----	----	----	----	500	----

Notes:
[1]Marysville and Smartsville gage flows represent average daily flows for the specified time period. Actual flows may vary from the indicated flows according to established criteria.
[2]Marysville Gage Schedule 6 flows do not include an additional 30,000 available from groundwater substitution to be allocated according to established criteria.
[3]Smartville Gage Schedule A is used with Marysville Schedules 1, 2, 3, and 4.
[4]Smartville Gage Schedule B is used with Marysville Schedules 5 and 6.
Key: cfs = Cubic feet per second AF = Acre-feet

3.4 AGRICULTURAL DEMANDS

YCWA provides irrigation water supply to about 90,000 acres of farmland in western Yuba County. The agricultural demand season primarily extends from spring through summer, although water also is provided during the fall for rice stubble decomposition and waterfowl habitat.

The present annual irrigation diversion demand is about 305,000 acre-feet. This demand volume is not static, and has increased recently with the completion of the Wheatland Project, which started partial operation in 2009 and full phase 1 operation in 2010. The projected future irrigation demand is 345,000 acre-feet, the increase in demand primarily being attributable to full operation of the Wheatland Project.

Various water districts, irrigation districts, and mutual water companies have contracts with YCWA for delivery of water. Some of the parties that receive water from YCWA also have their own appropriative rights for diversion of water from the lower Yuba River. The individual water rights held by some of the YCWA Member Units are pre-1914 rights.

3.4.1 Member Units

Water diverted under YCWA's water right permits is delivered to Brophy Water District (BWD), Browns Valley Irrigation District (BVID), Cordua Irrigation District (CID), Dry Creek Mutual

Water Company (DCMWC), Hallwood Irrigation Company (HIC), Ramirez Water District (RWD), South Yuba Water District (SYWD), and WWD. BVID diverts water at the Pumpline Diversion Facility, located 1 mile upstream from Daguerre Point Dam. CID, HIC, and RWD receive water through the Hallwood-Cordua Canal (North Canal), located on the north abutment of Daguerre Point Dam. BWD, SYWD, DCMWC, and WWD receive water through the Yuba Main Canal (South Canal), located on the south side of the lower Yuba River slightly upstream from the south abutment of Daguerre Point Dam. YCWA also provides surface water to the City of Marysville for diversion from the lower Yuba River and use at Lake Ellis.

3.4.2 Diversion Delivery Shortages

Irrigation deliveries that are less than the delivery demand (shortages) are imposed in two ways. Demand delivery shortages are imposed if, under the normal demand, storage in New Bullards Bar Reservoir is forecasted to be below the carryover storage target at the end of September. In a year when this low storage level is forecast, the diversion delivery shortage is applied at a volume equal to the volume that the forecasted storage is below the carryover storage target, resulting in meeting this target.

The carryover storage requirement is relaxed when it would result in a delivery shortage of more than 50 percent in the current year. This is because YCWA would not operate the YRDP in such a manner as to impose deficiencies of 50 percent or greater in the current year to protect against the risk of a 50 percent curtailment in the following year.

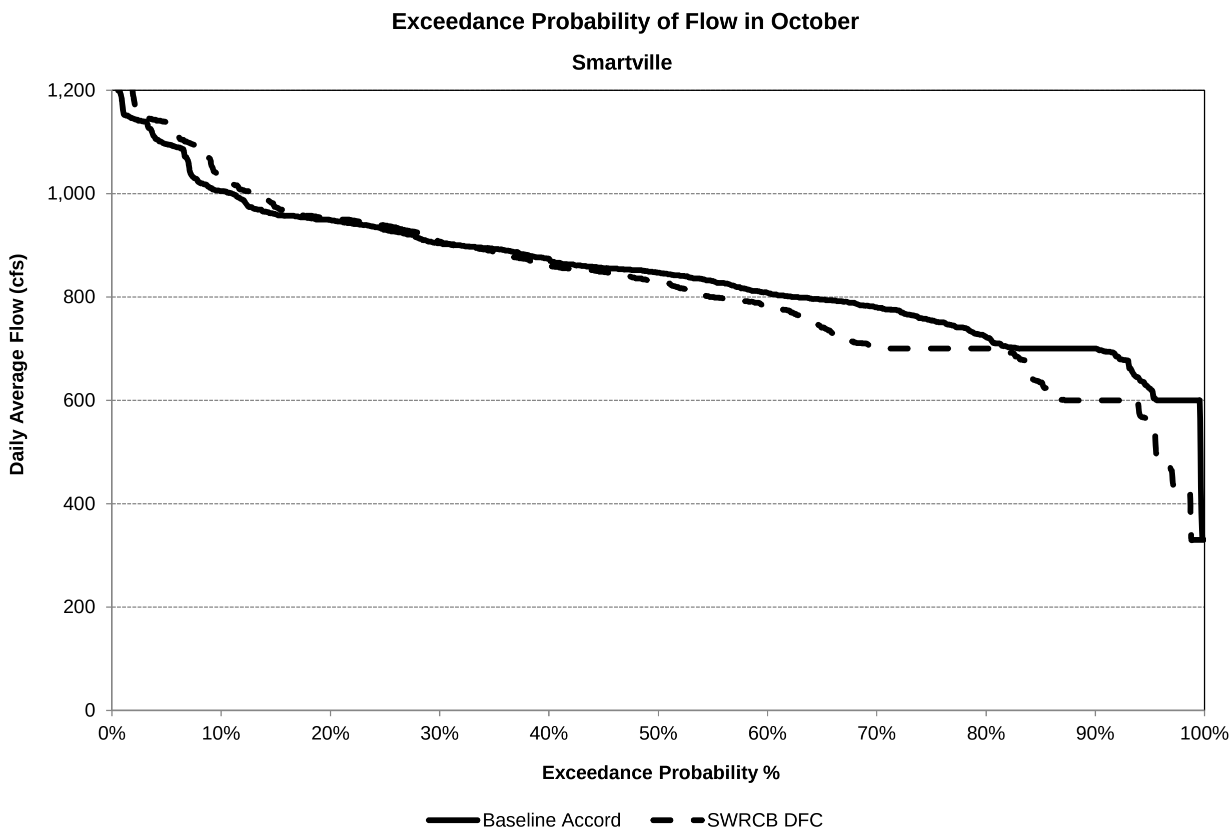
The second way that irrigation deliveries would be shorted is unique to the SWRCB DFC. In wetter years, 75% of the unimpaired flow is more than the release capacity of the YRDP. During those times, mainly in the spring when irrigation commences, there could be no irrigation diversions, as these would further reduce the outflow of the Yuba River and increase the violation of the SWRCB DFC requirements.

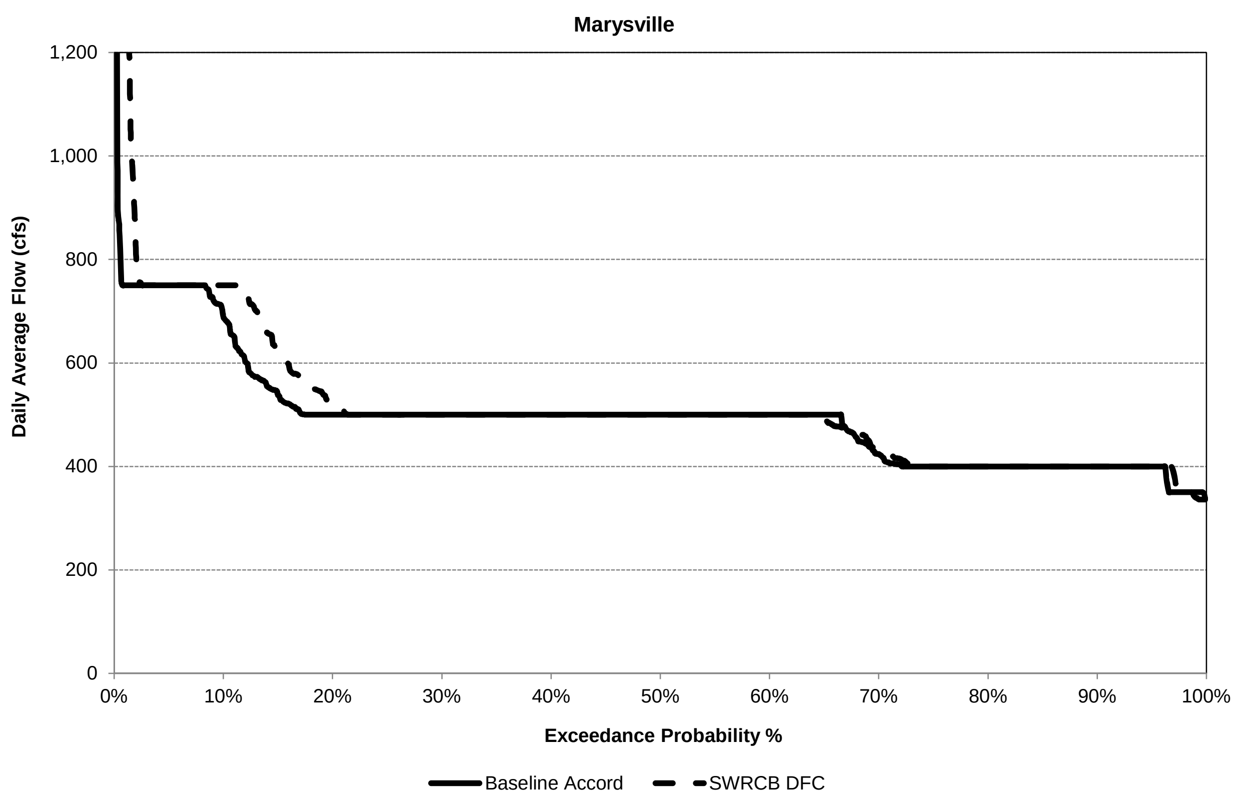
Appendix C: Flow Exceedance Plots:

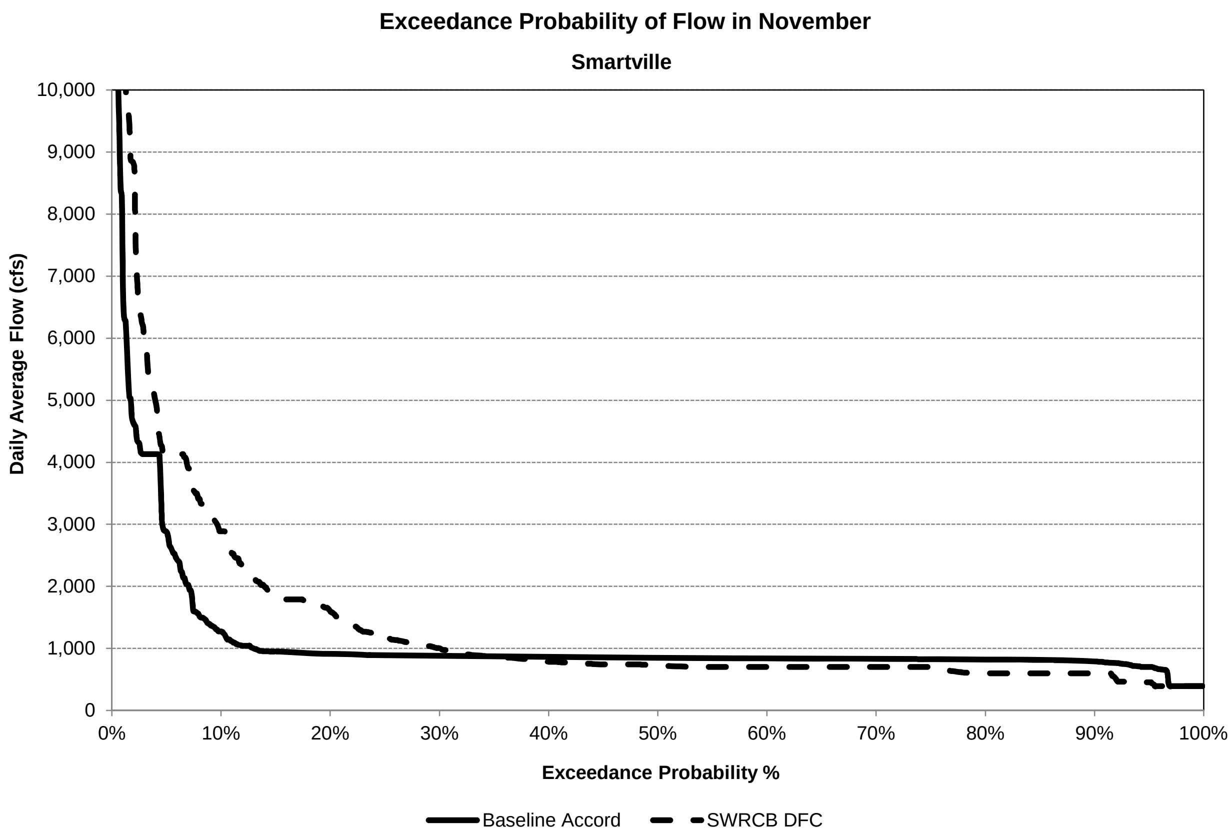
SWRCB Delta Flow Criteria Scenario (75% of unimpaired flow)

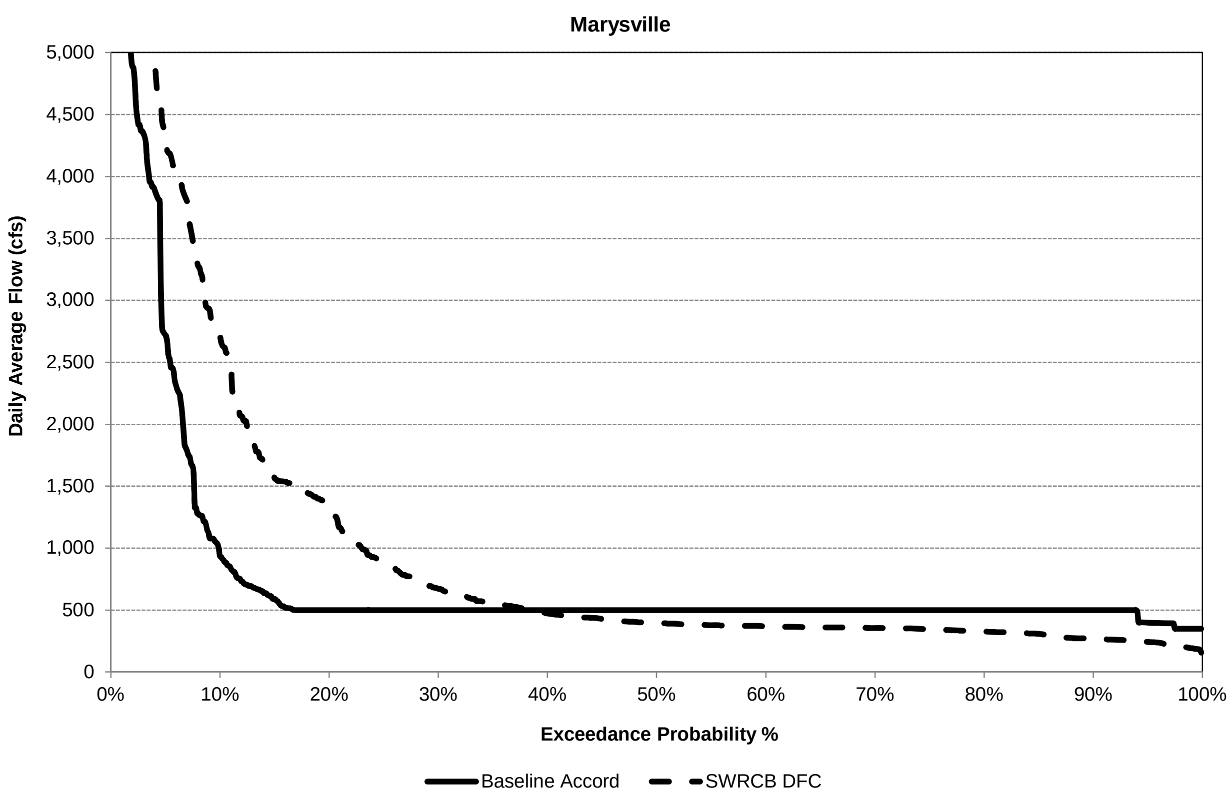
60% of Unimpaired Flow Scenario

50% of Unimpaired Flow Scenario

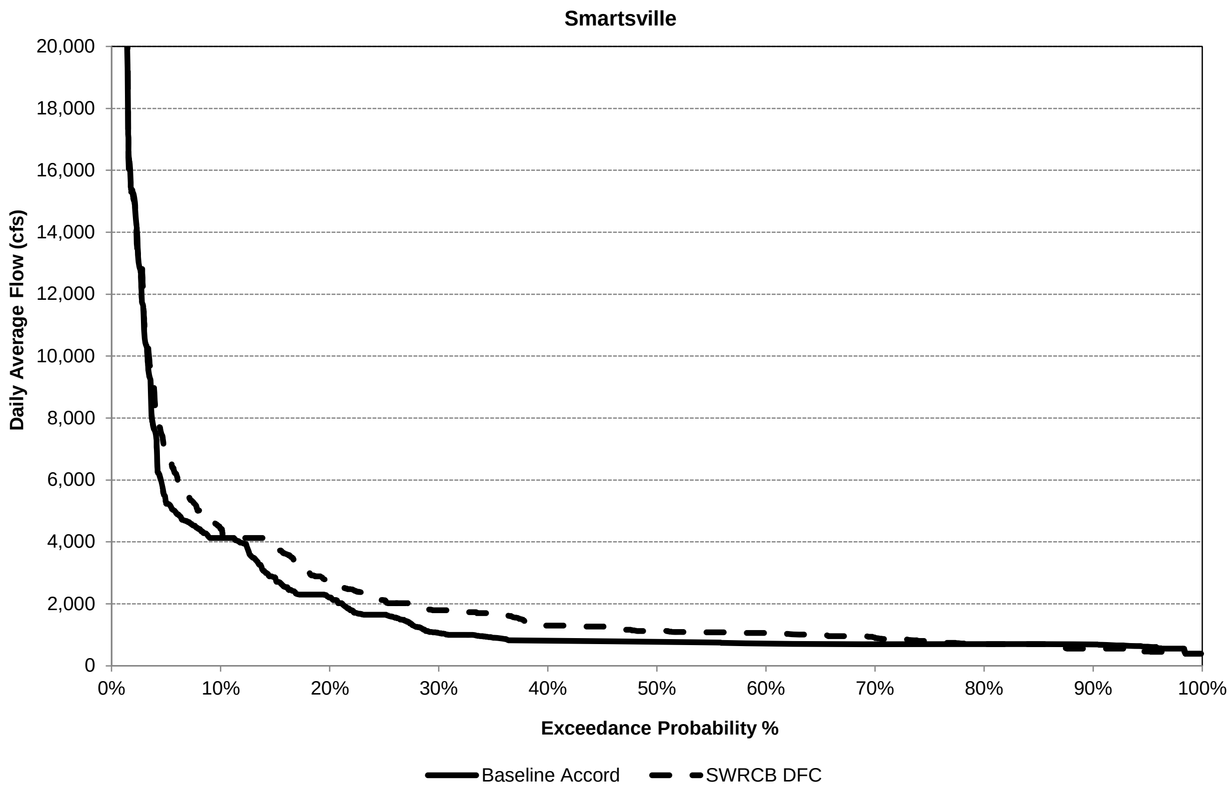

Exceedance Probability of Flow in October
Smartville
Daily Average Flow (cfs)
1,200
1,000
800
600
400
200
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance Probability %
Baseline Accord
SWRCB DFC

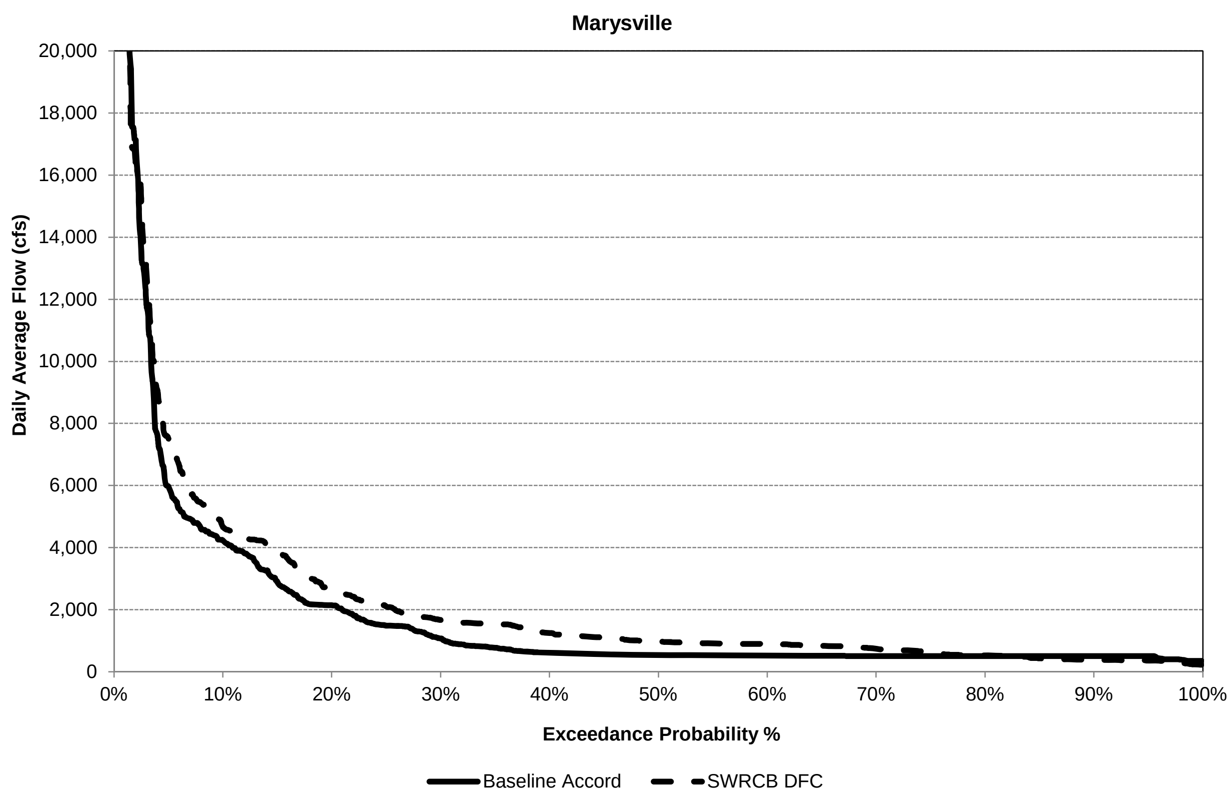

Marysville
Daily Average Flow (cfs)
1,200
1,000
800
600
400
200
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance Probability %
Baseline Accord
SWRCB DFC


Exceedance Probability of Flow in November
Smartville
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
Daily Average Flow (cfs)
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance Probability %
Baseline Accord
SWRCB DFC

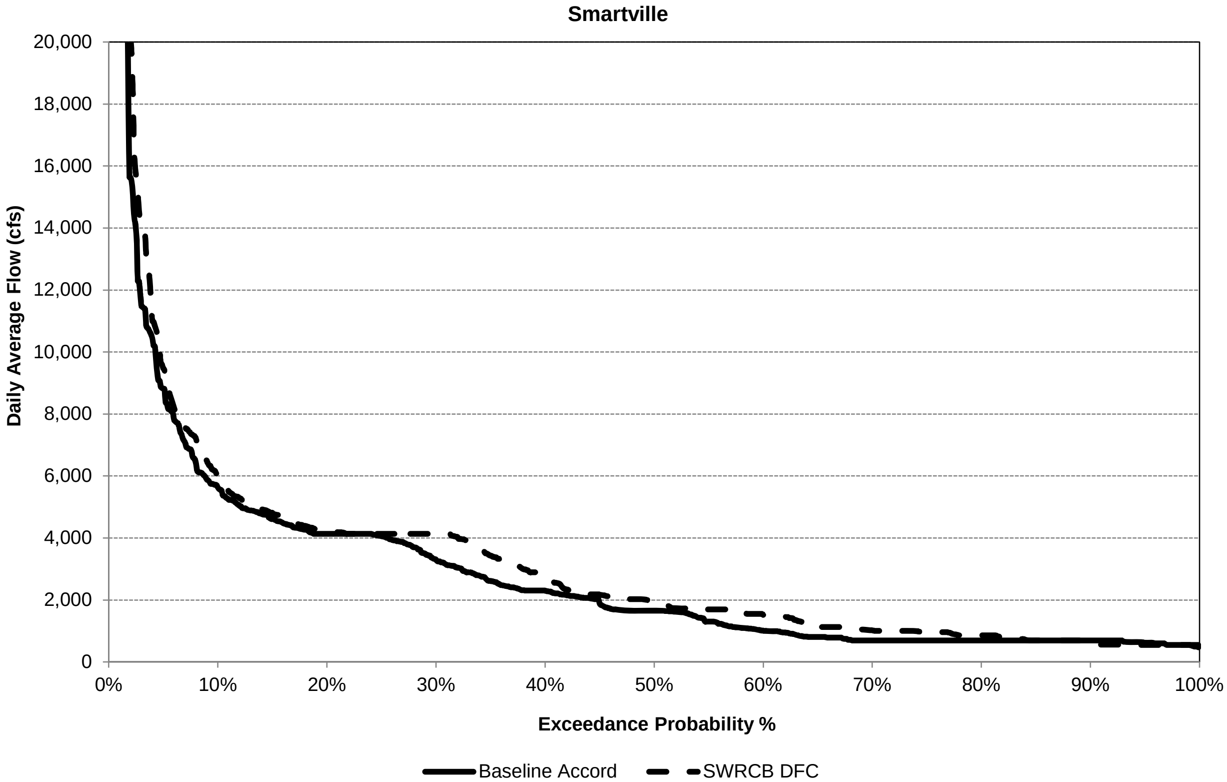

Marysville
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Daily Average Flow (cfs)
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance Probability %
Baseline Accord
SWRCB DFC

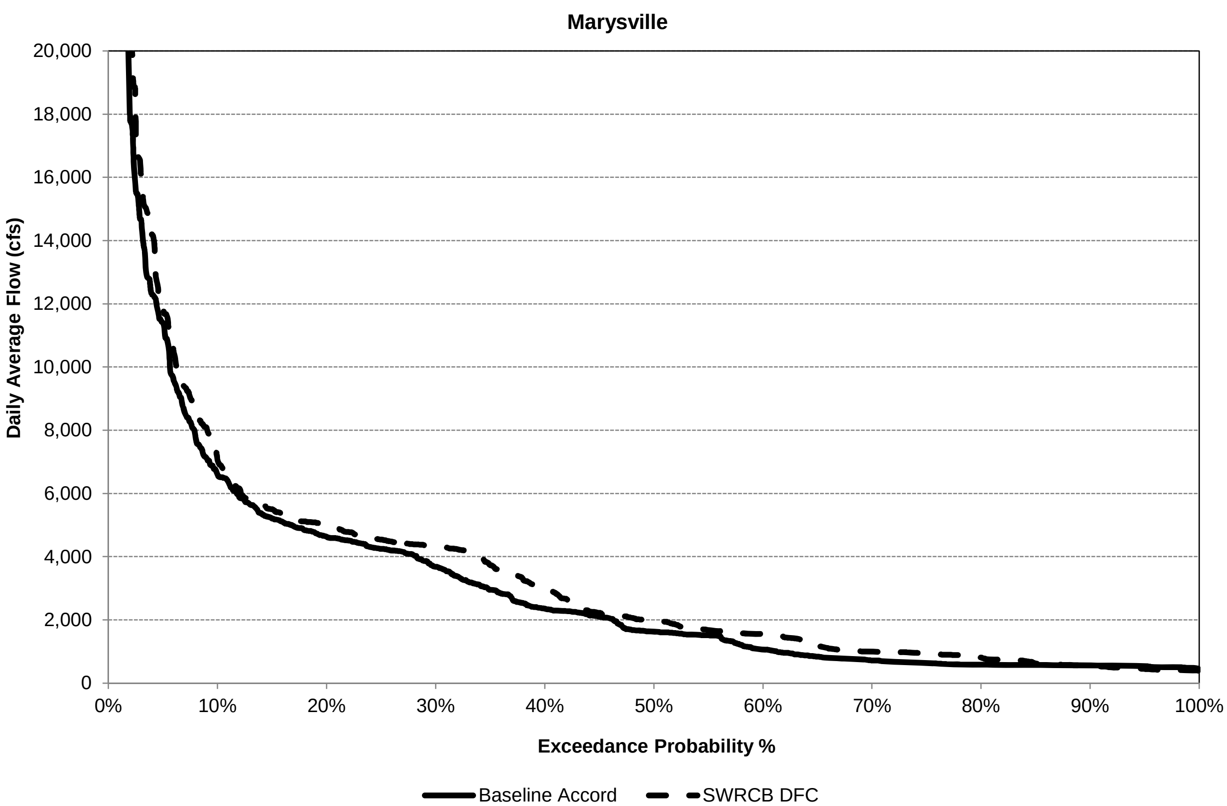
Exceedance Probability of Flow in December





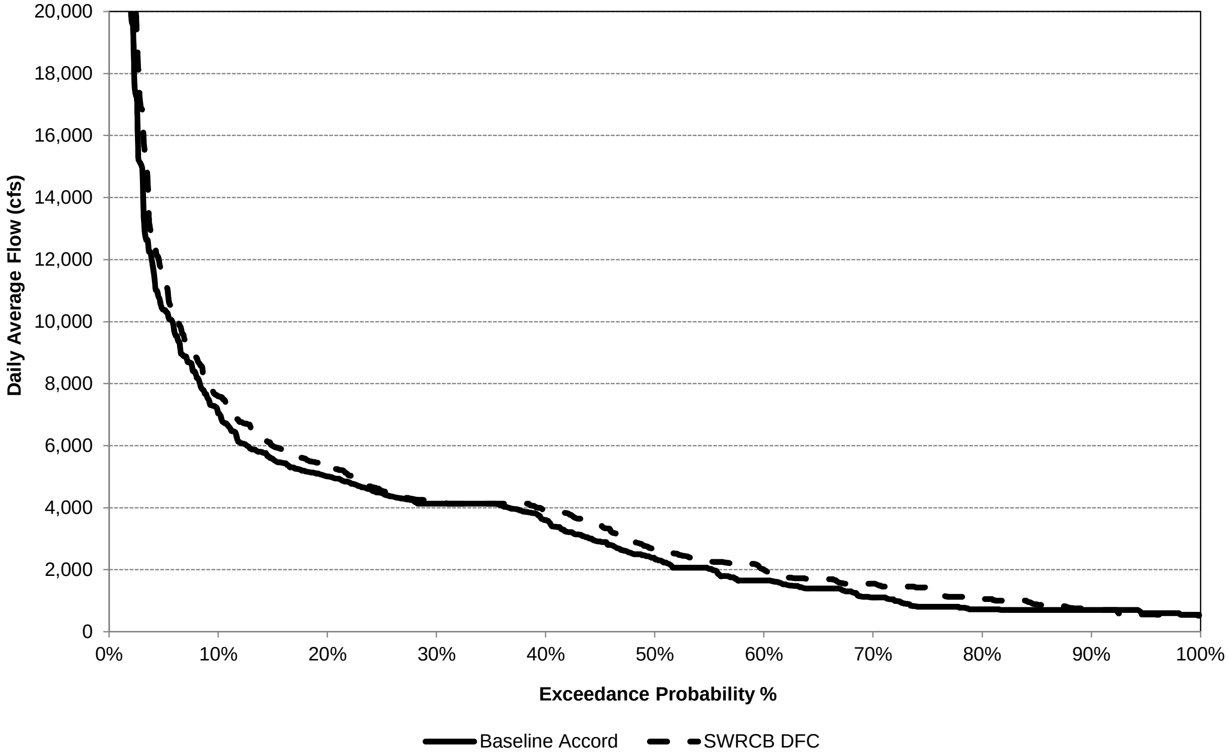
Exceedance Probability of Flow in January



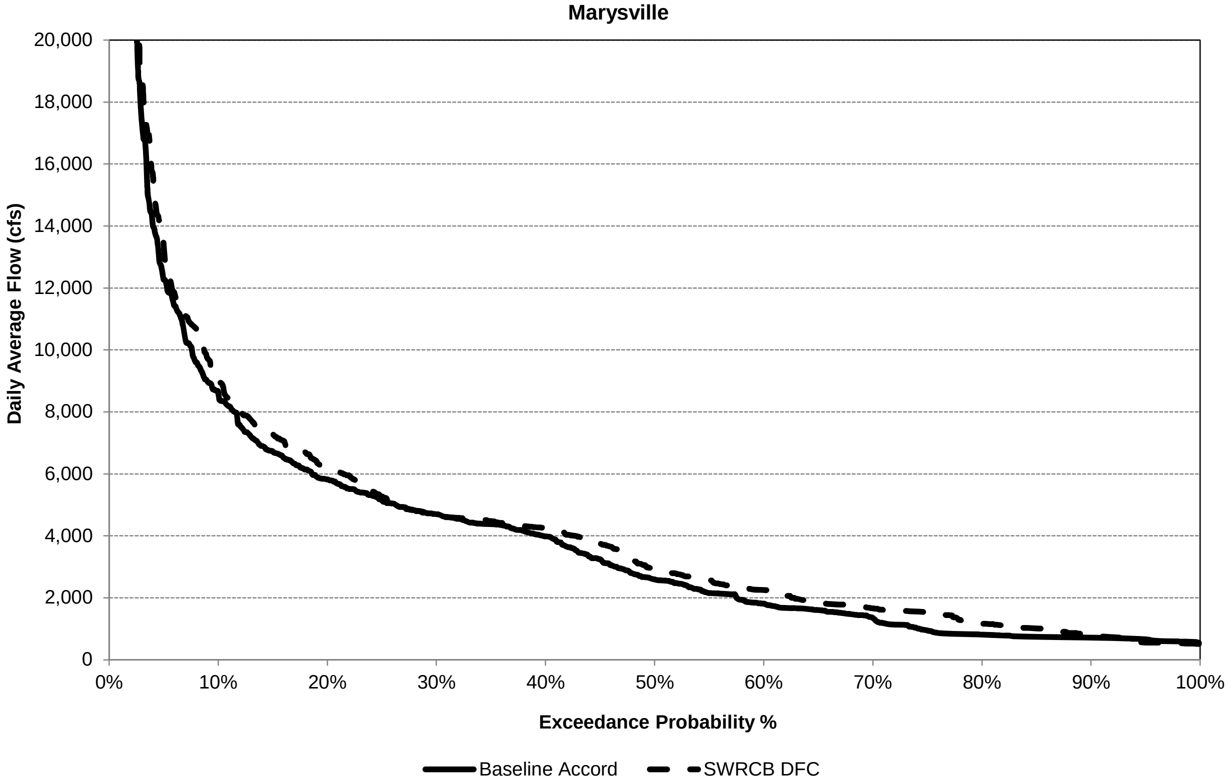


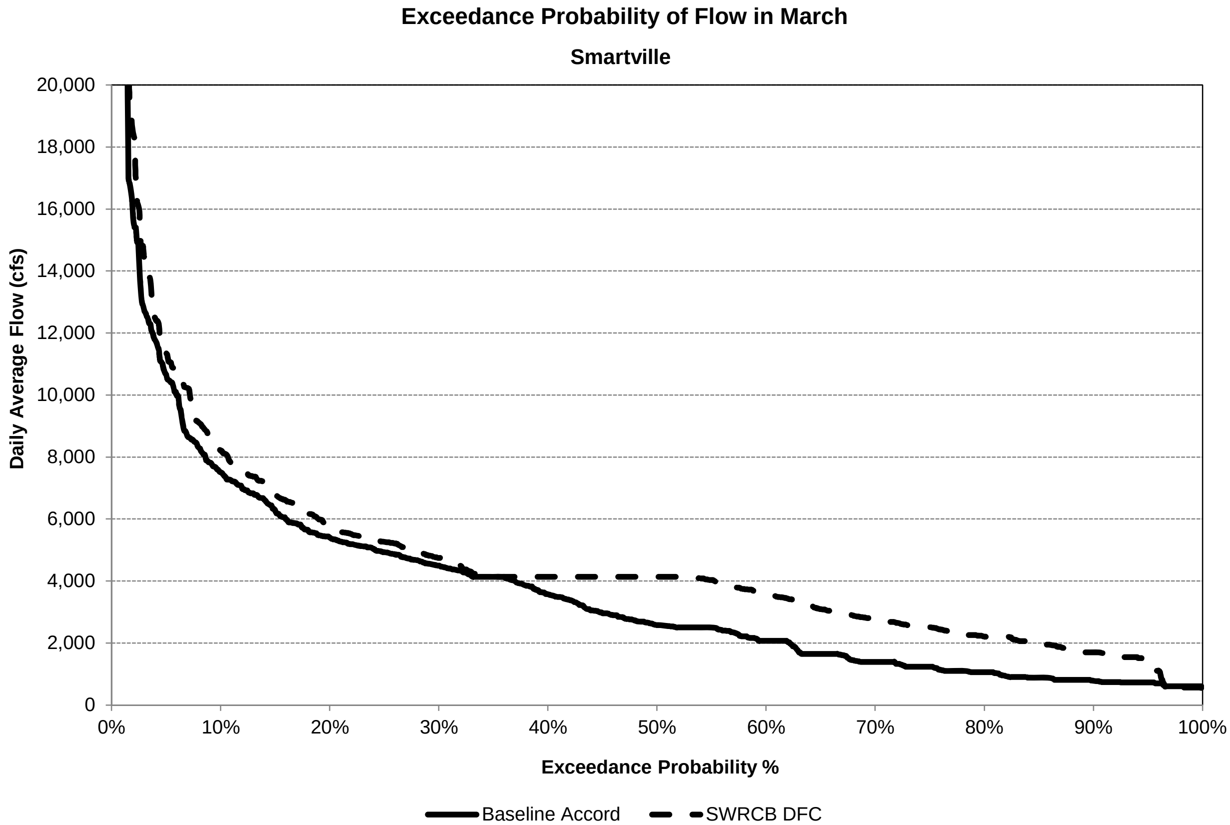
Exceedance Probability of Flow in February

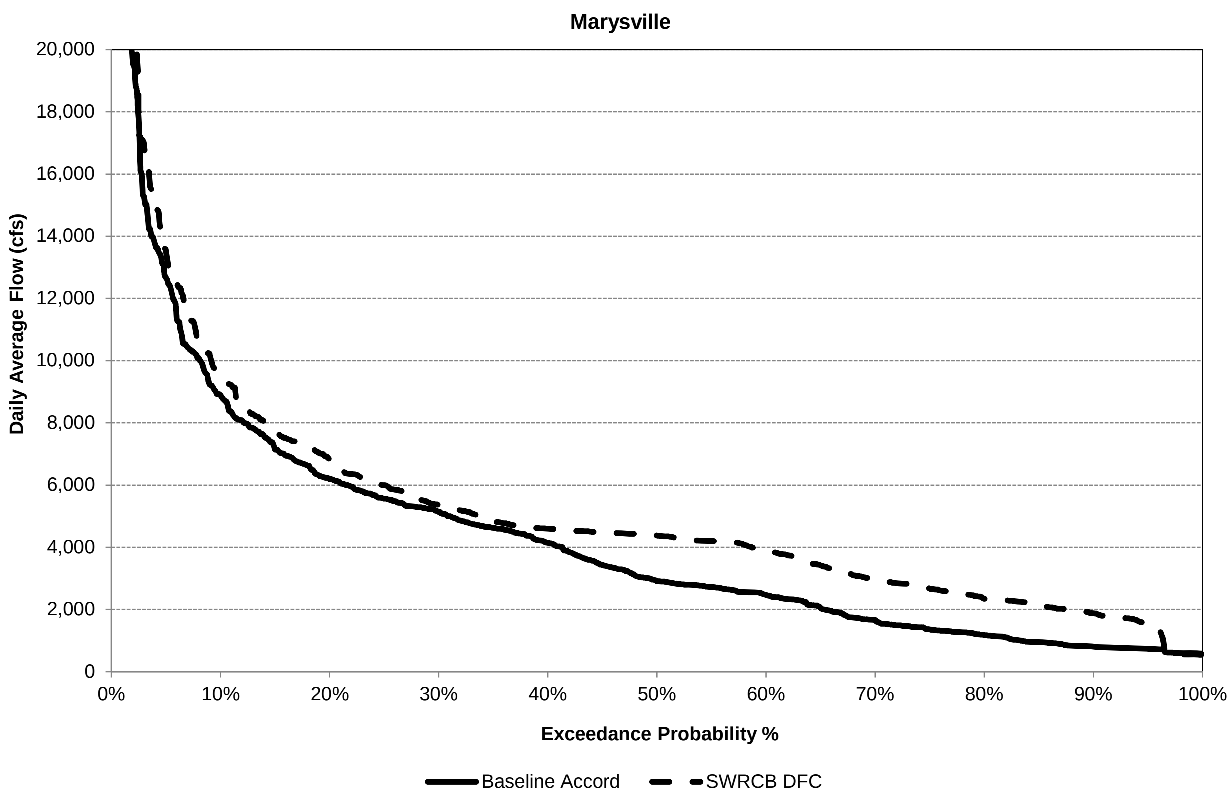
Smartville

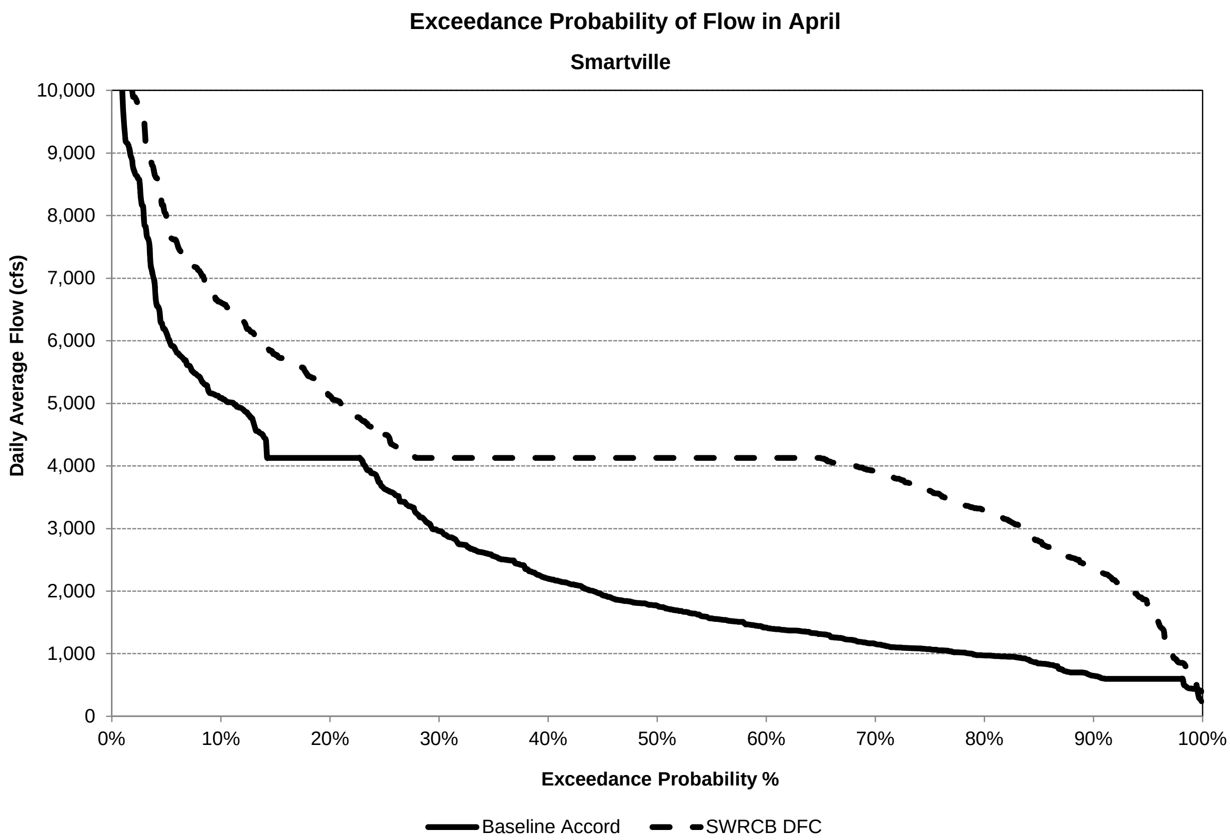


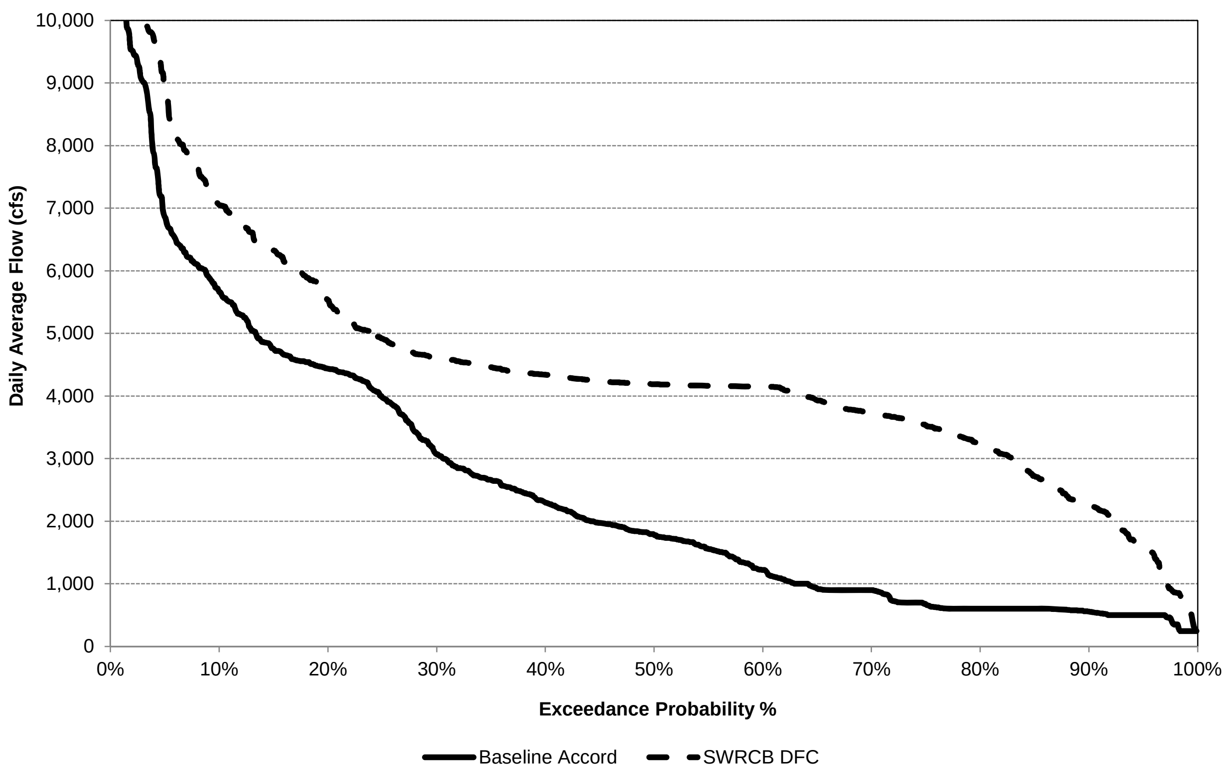
Marysville

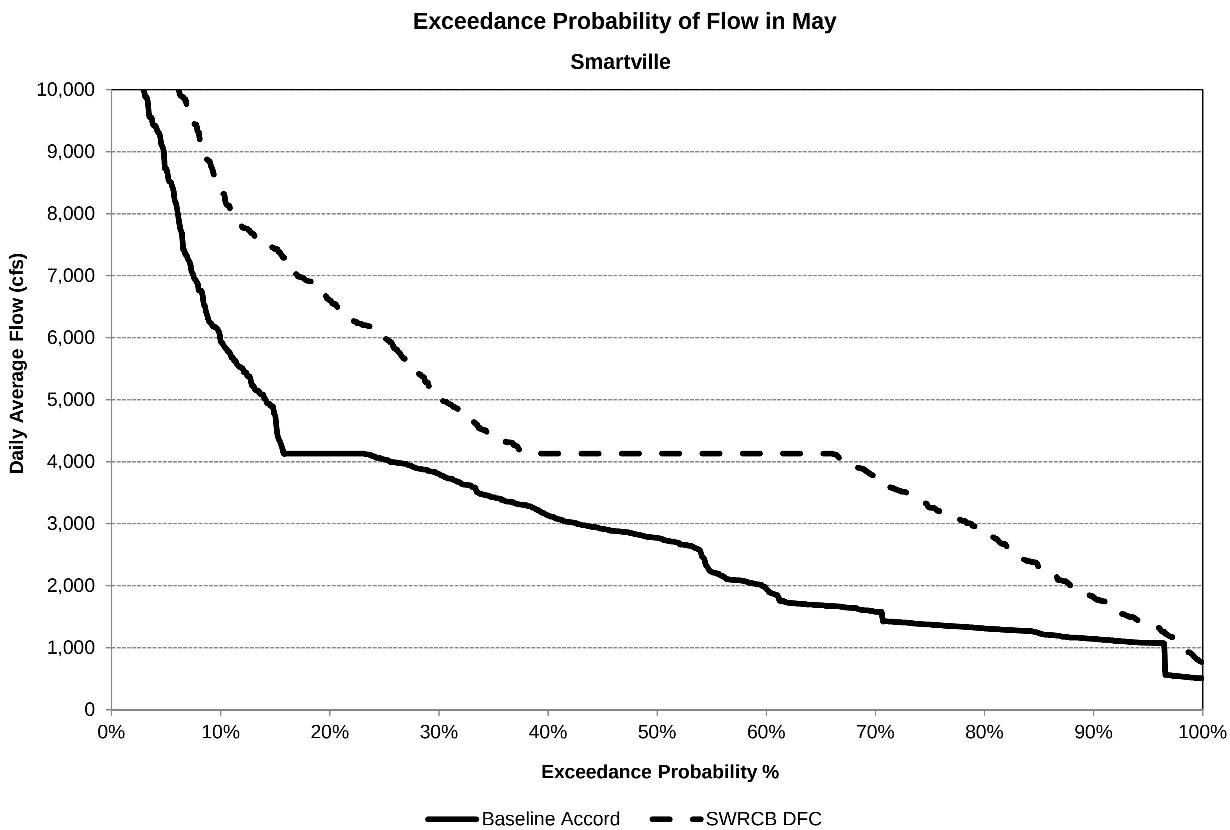


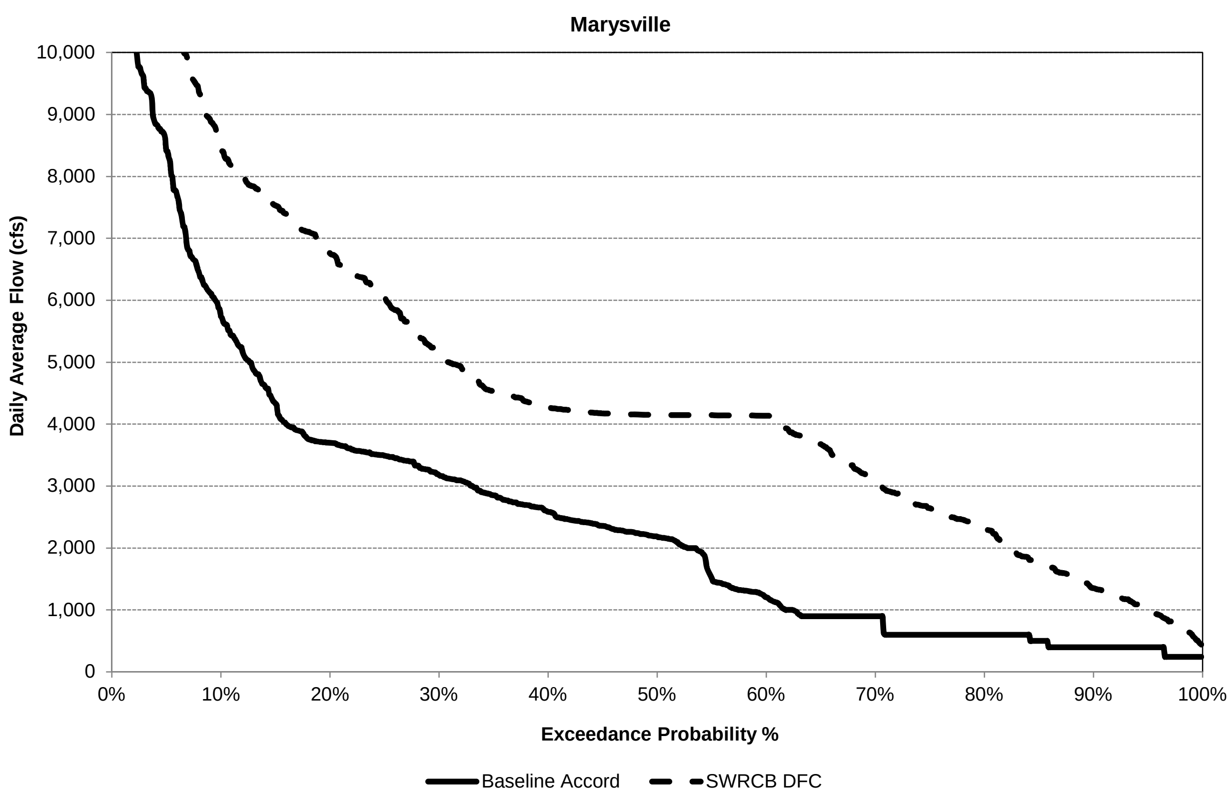

Exceedance Probability of Flow in March
Smartville
Daily Average Flow (cfs)
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance Probability %
Baseline Accord
SWRCB DFC

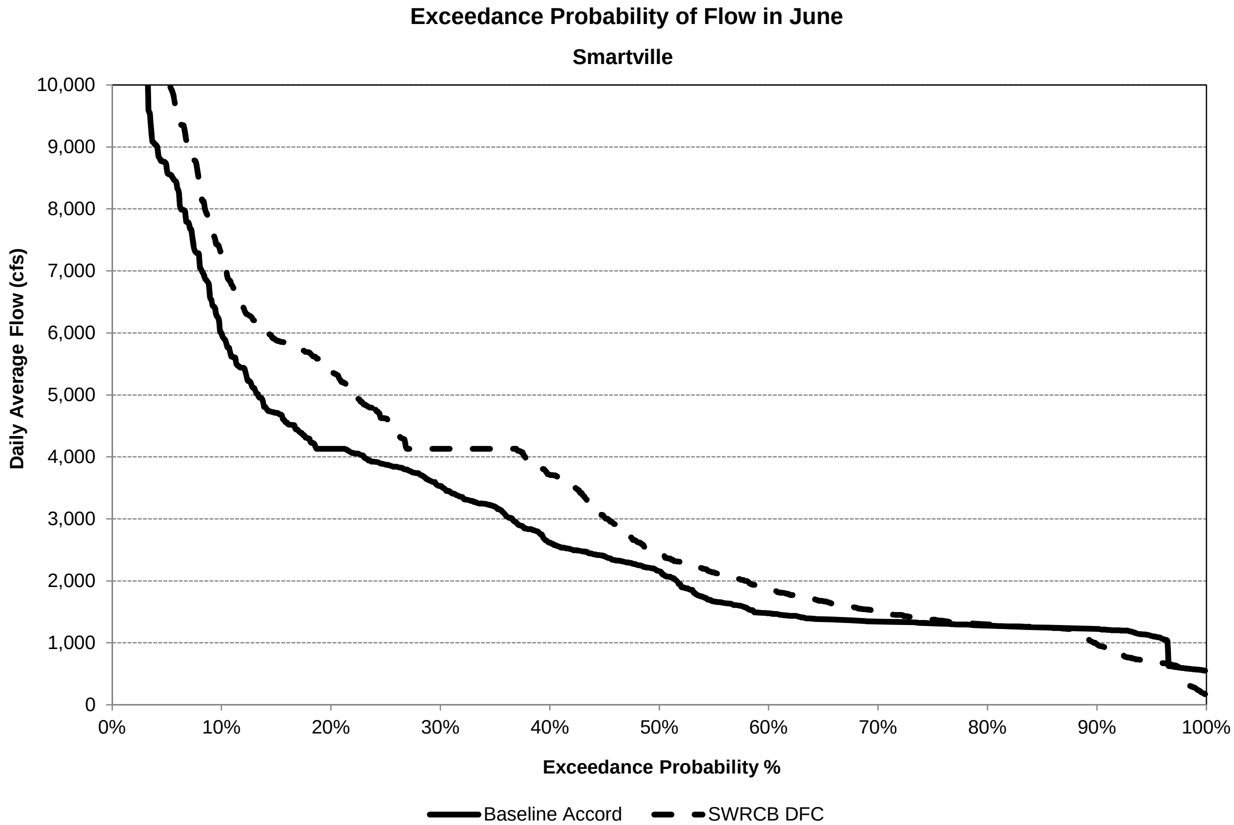

Marysville
Daily Average Flow (cfs)
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance Probability %
Baseline Accord
SWRCB DFC

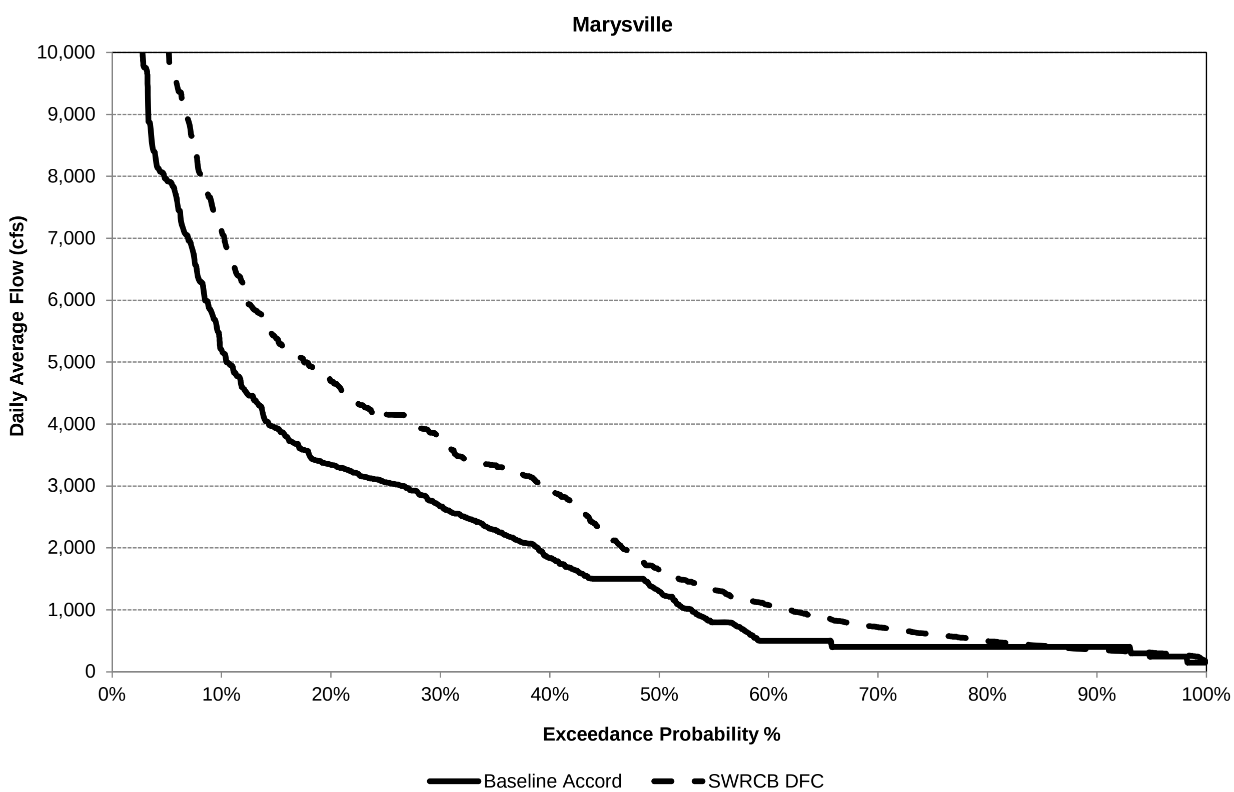

Exceedance Probability of Flow in April
Smartville
Daily Average Flow (cfs)
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance Probability %
Baseline Accord
SWRCB DFC


Daily Average Flow (cfs)
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance Probability %
Baseline Accord
SWRCB DFC

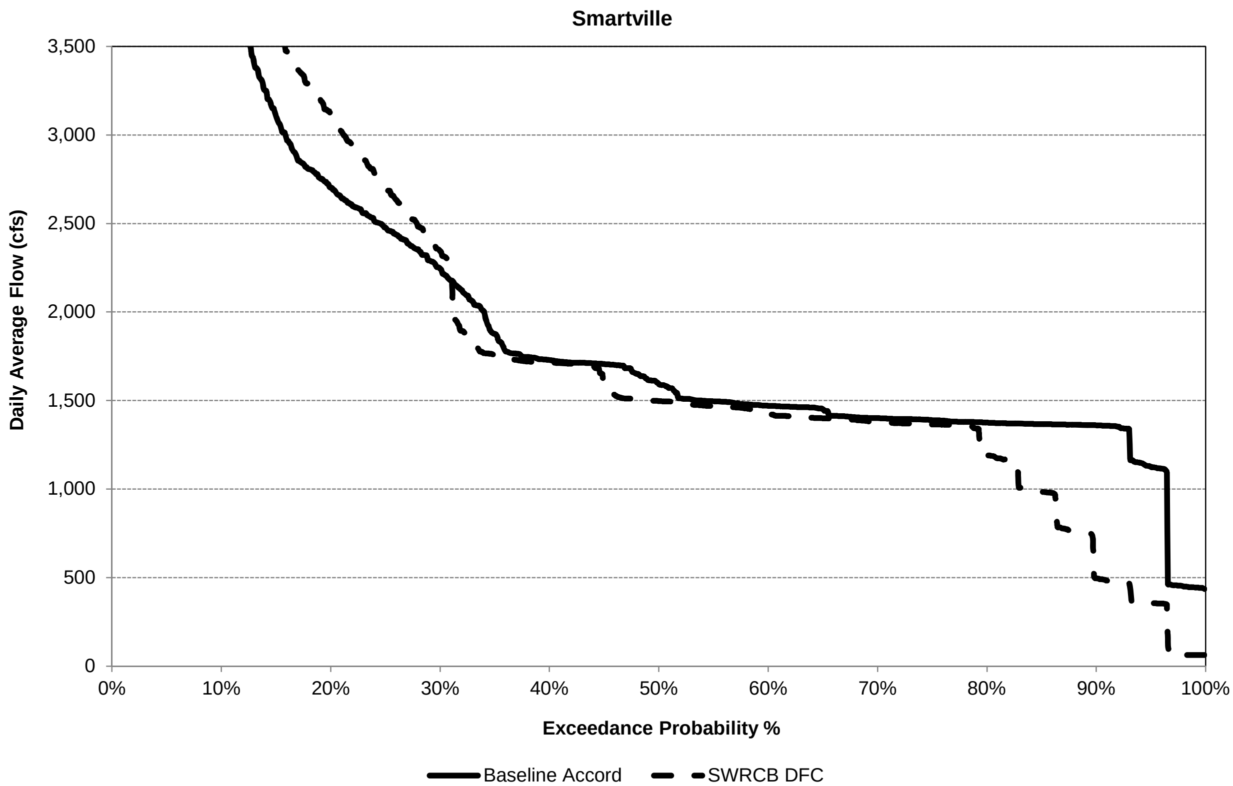

Exceedance Probability of Flow in May
Smartville
Daily Average Flow (cfs)
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance Probability %
Baseline Accord
SWRCB DFC

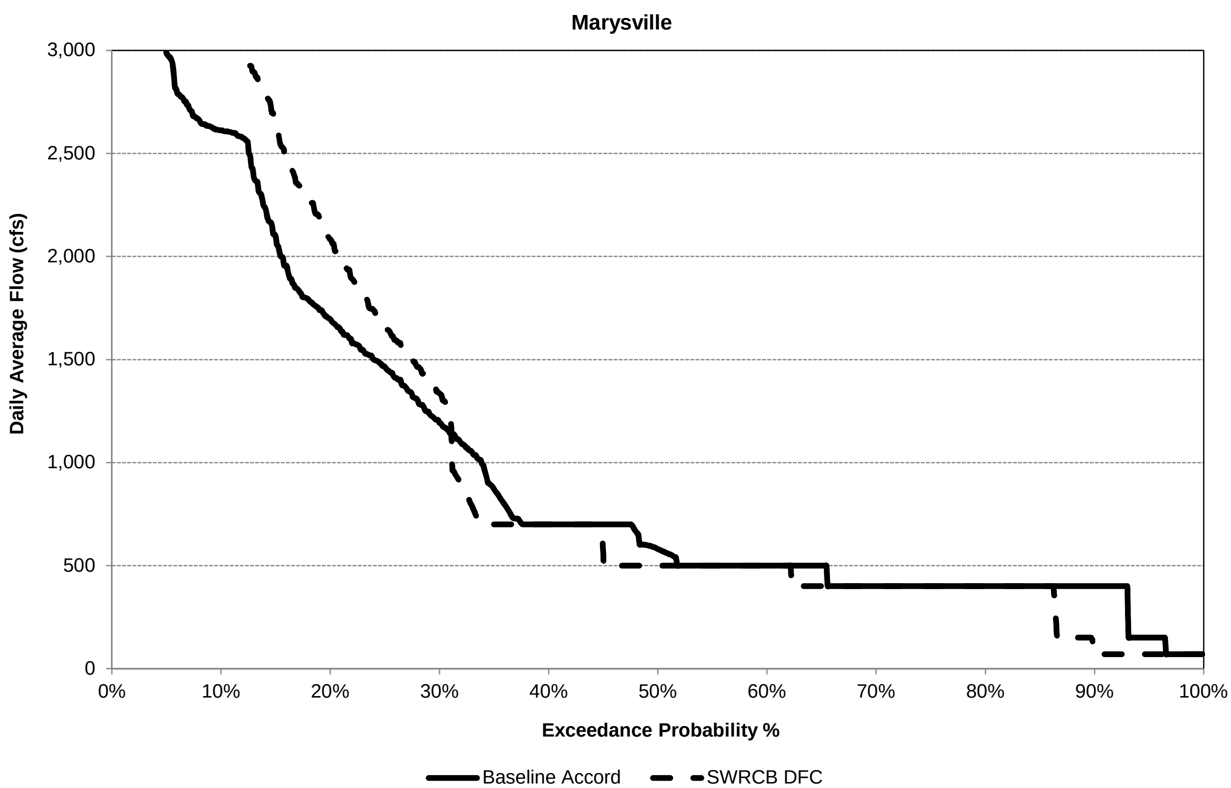

Marysville
Daily Average Flow (cfs)
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance Probability %
Baseline Accord
SWRCB DFC


Exceedance Probability of Flow in June
Smartville
Daily Average Flow (cfs)
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance Probability %
Baseline Accord
SWRCB DFC

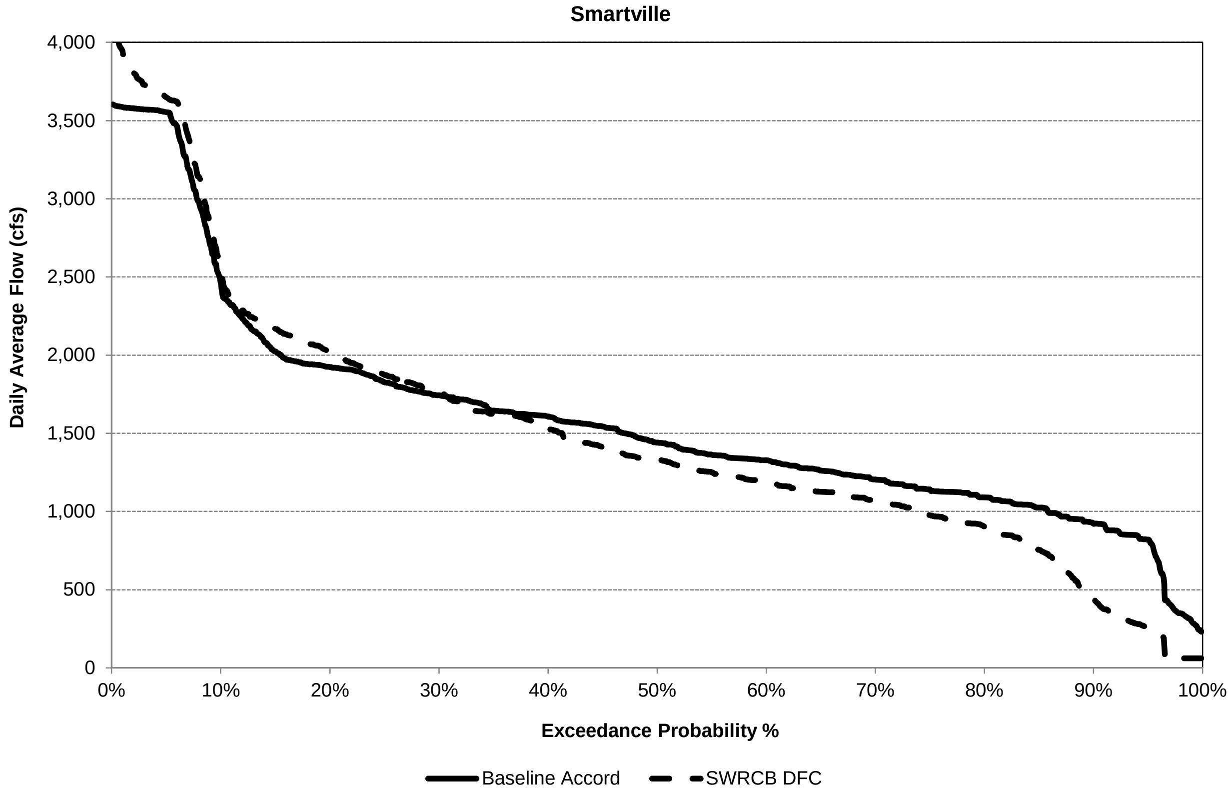

Marysville
Daily Average Flow (cfs)
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance Probability %
Baseline Accord
SWRCB DFC

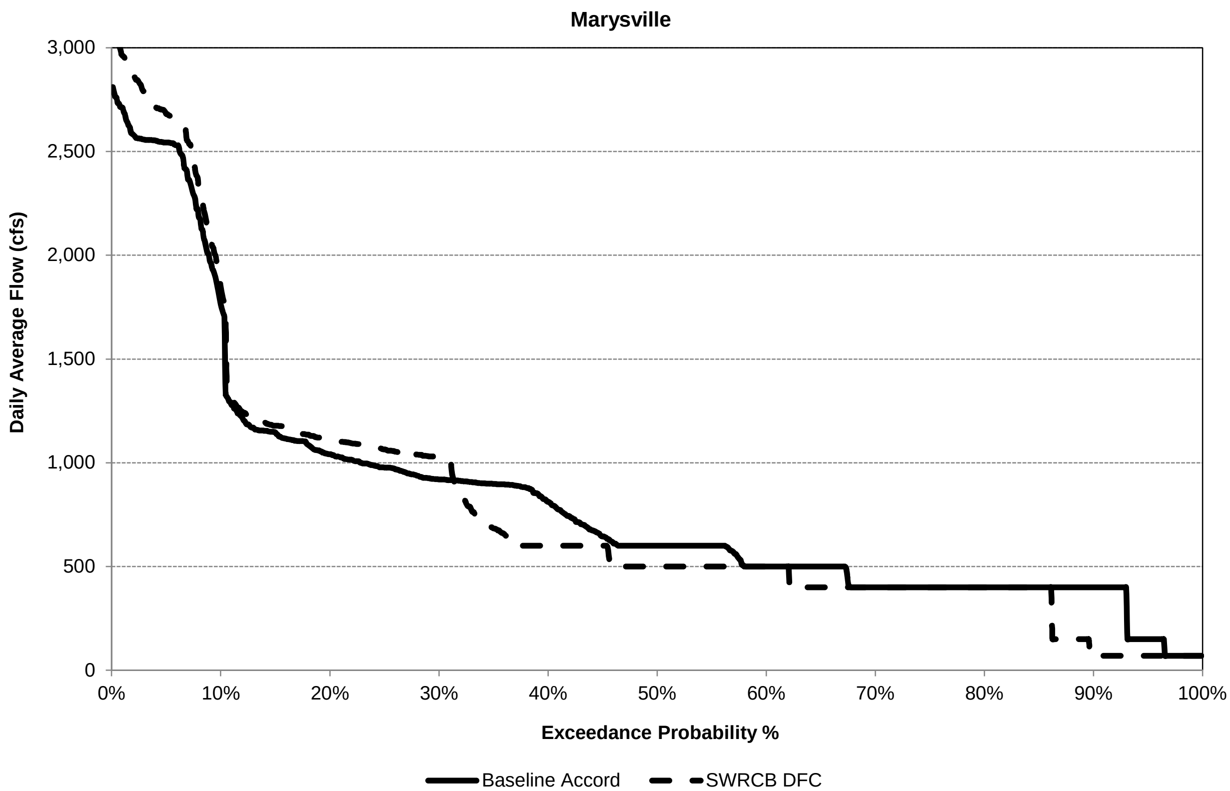
Exceedance Probability of Flow in July



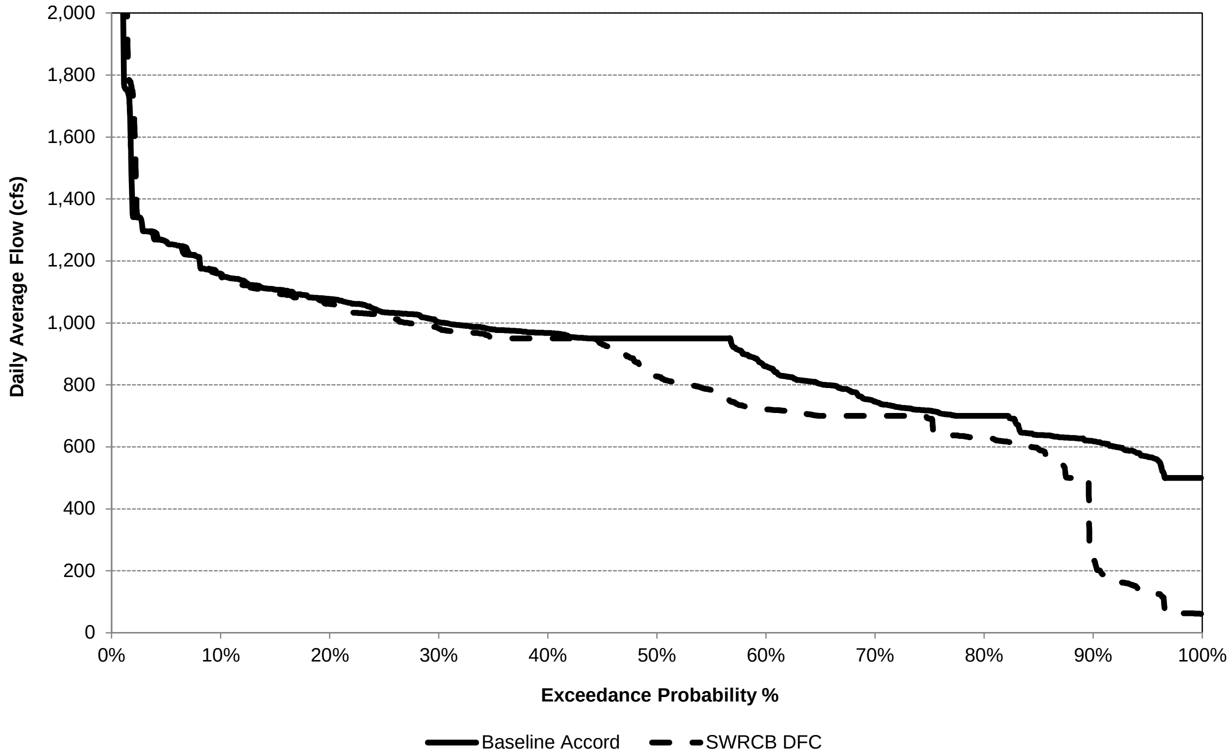


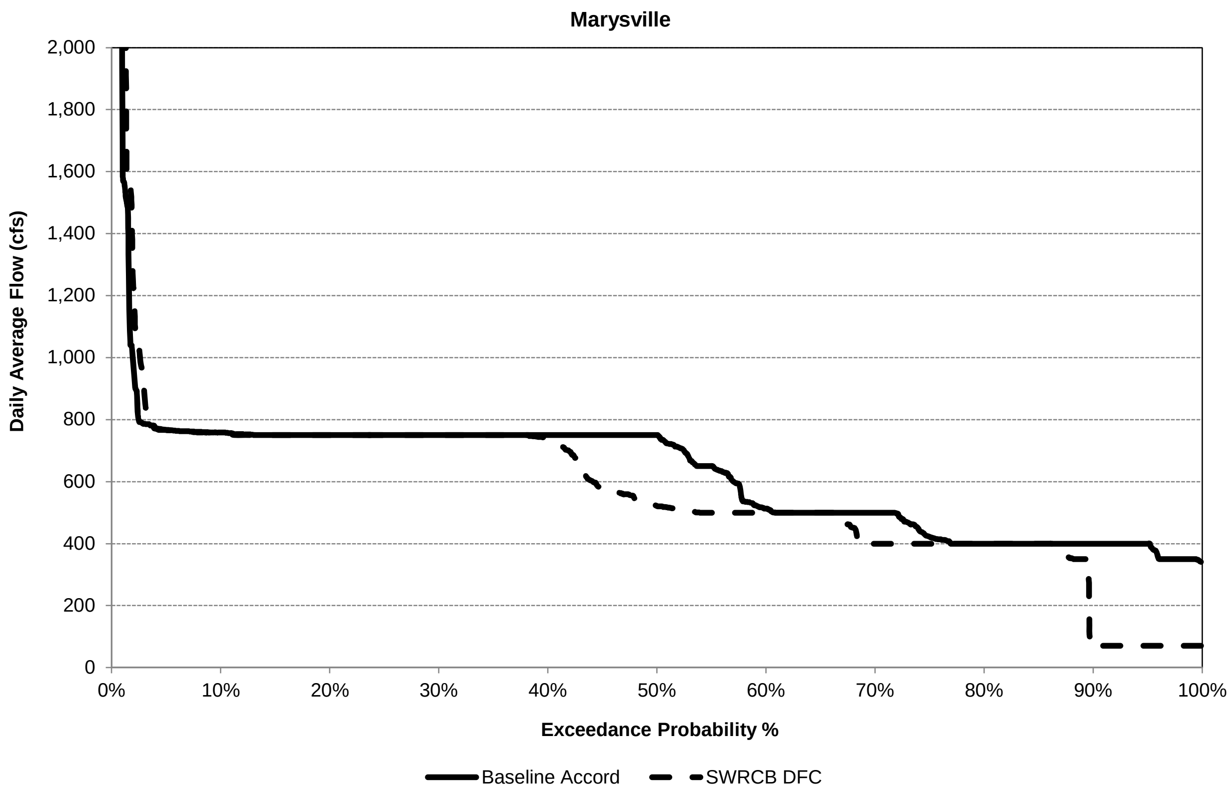
Exceedance Probability of Flow in August



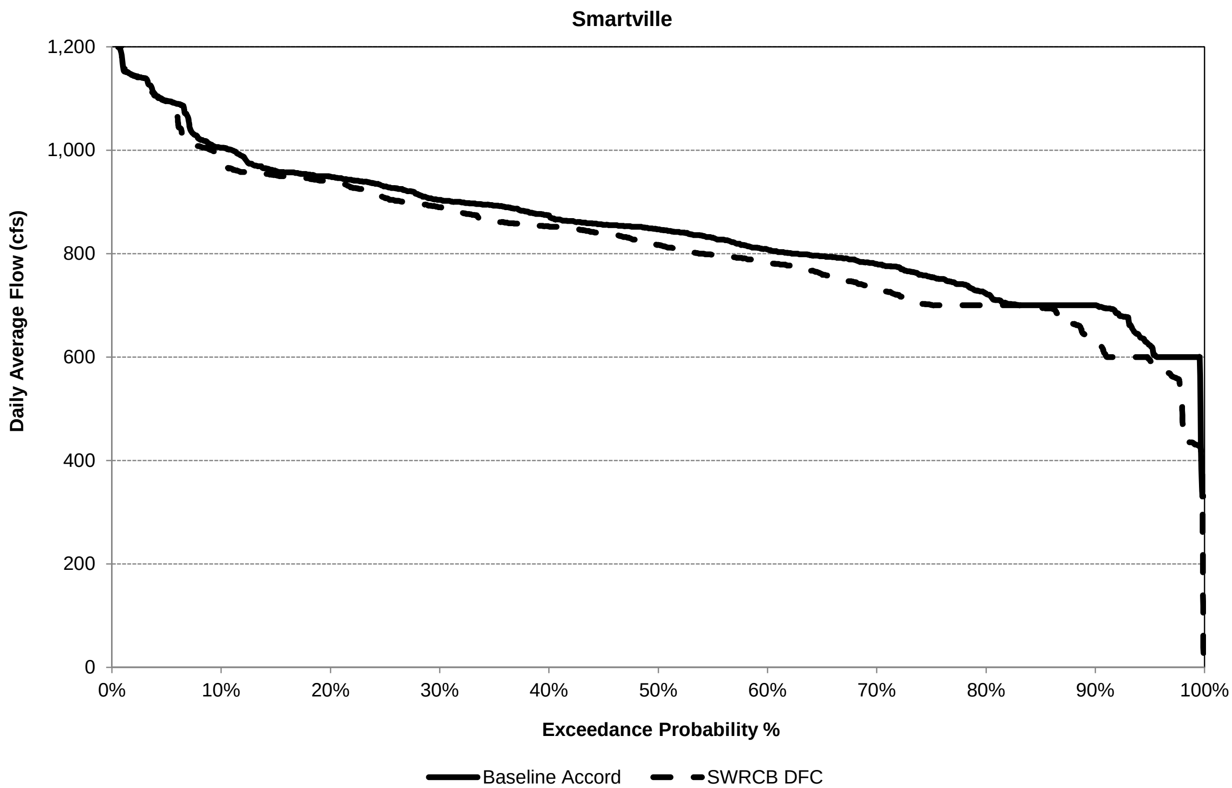


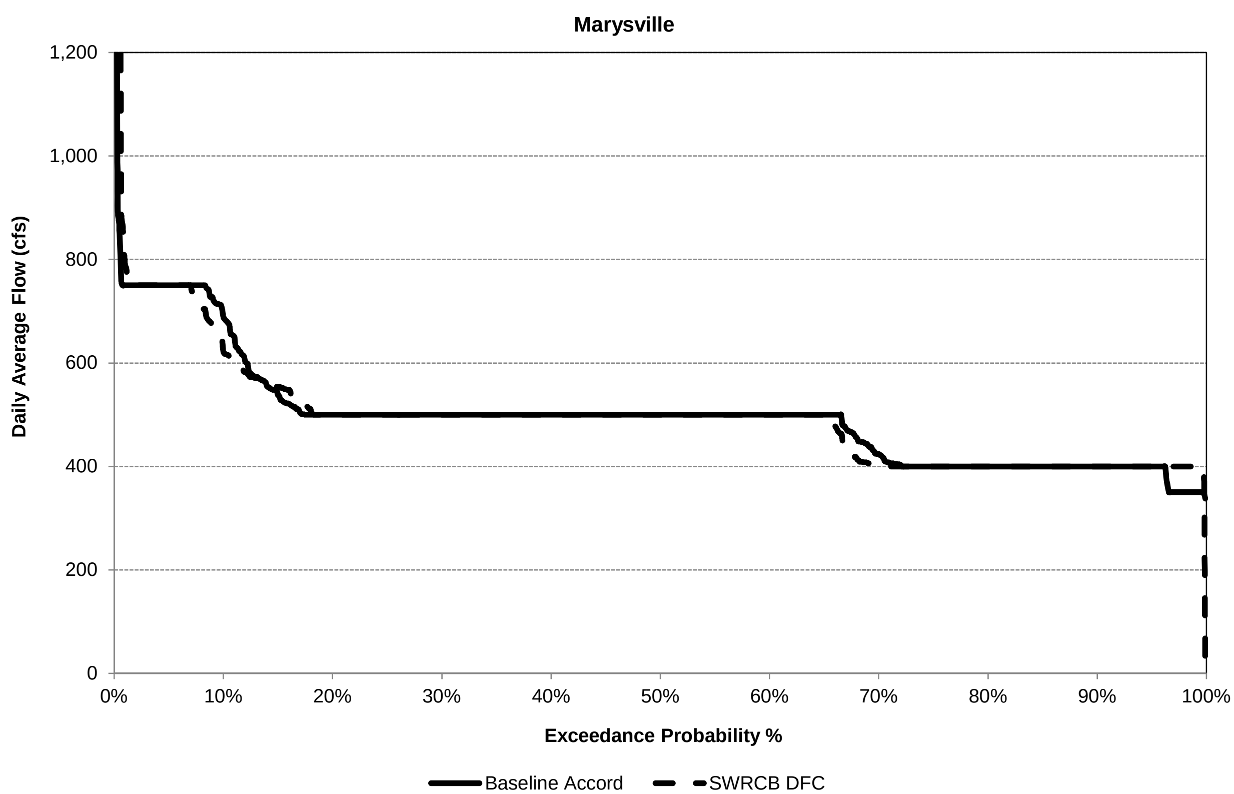
Exceedance Probability of Flow in September

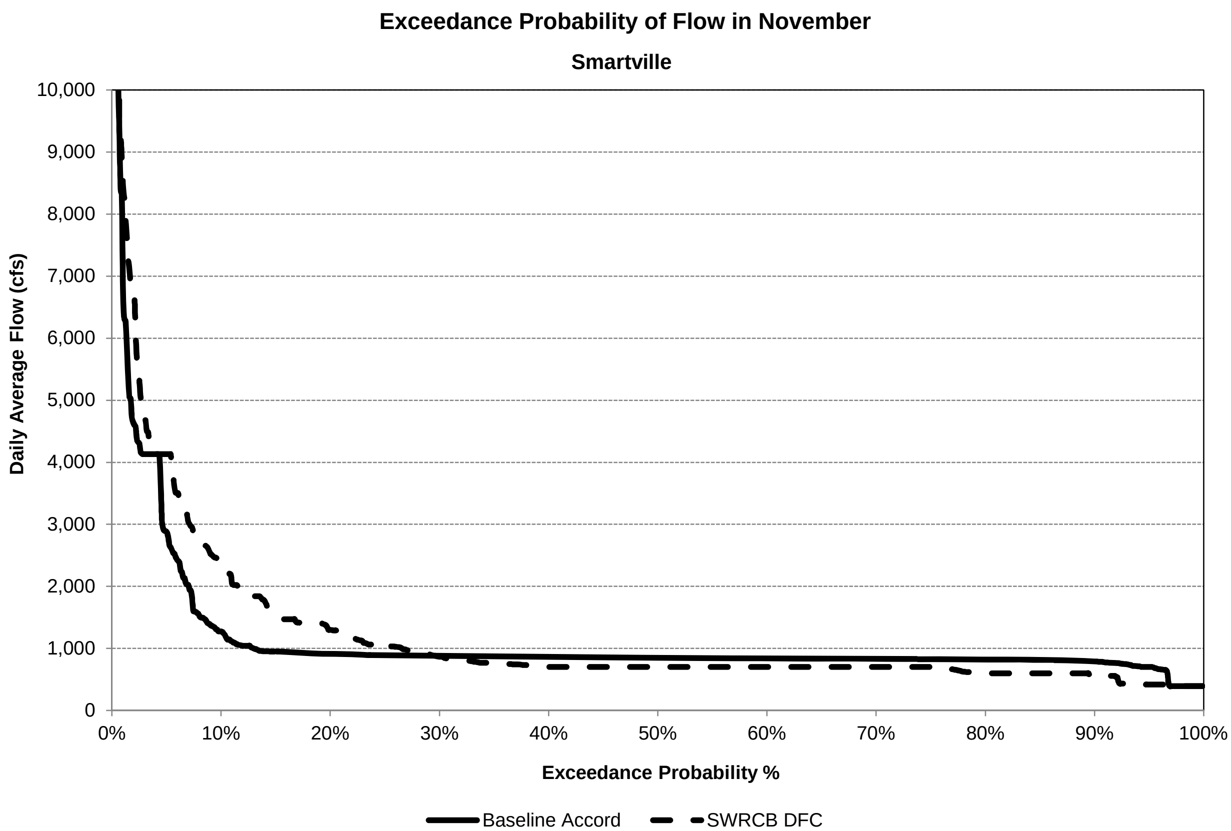


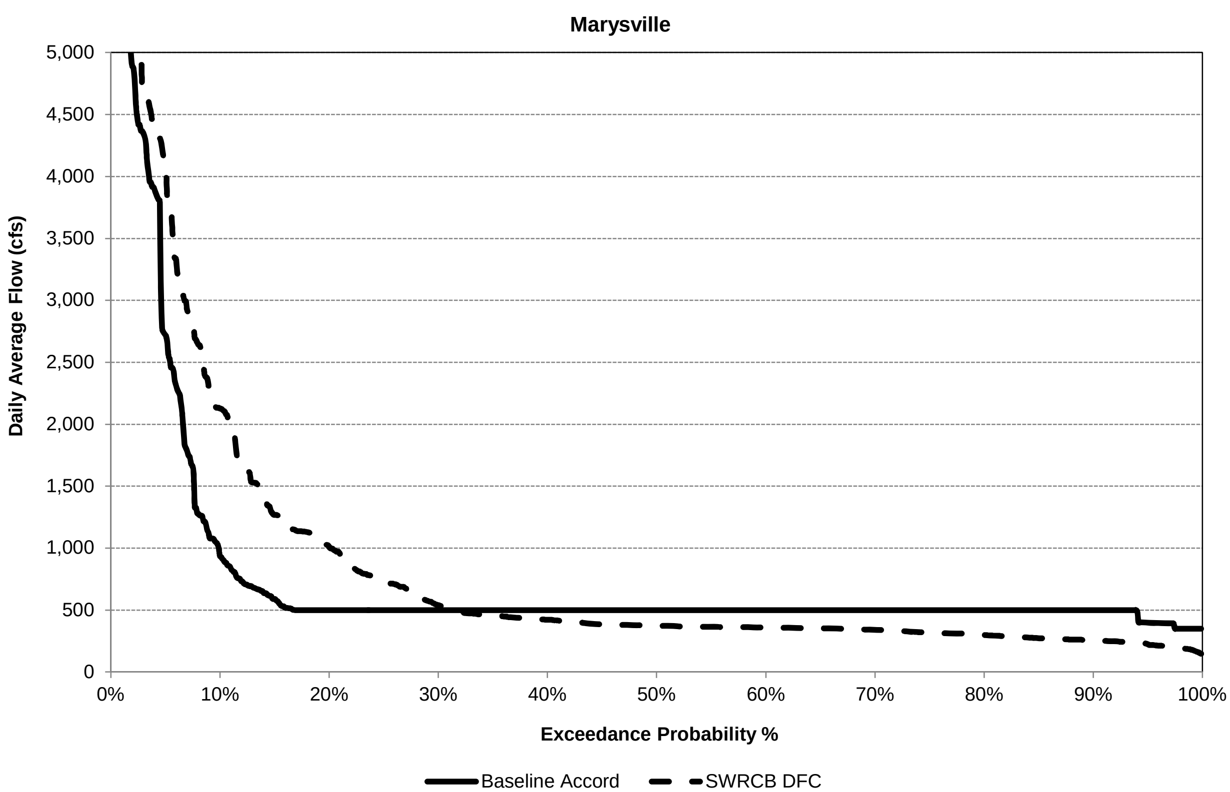


Exceedance Probability of Flow in October

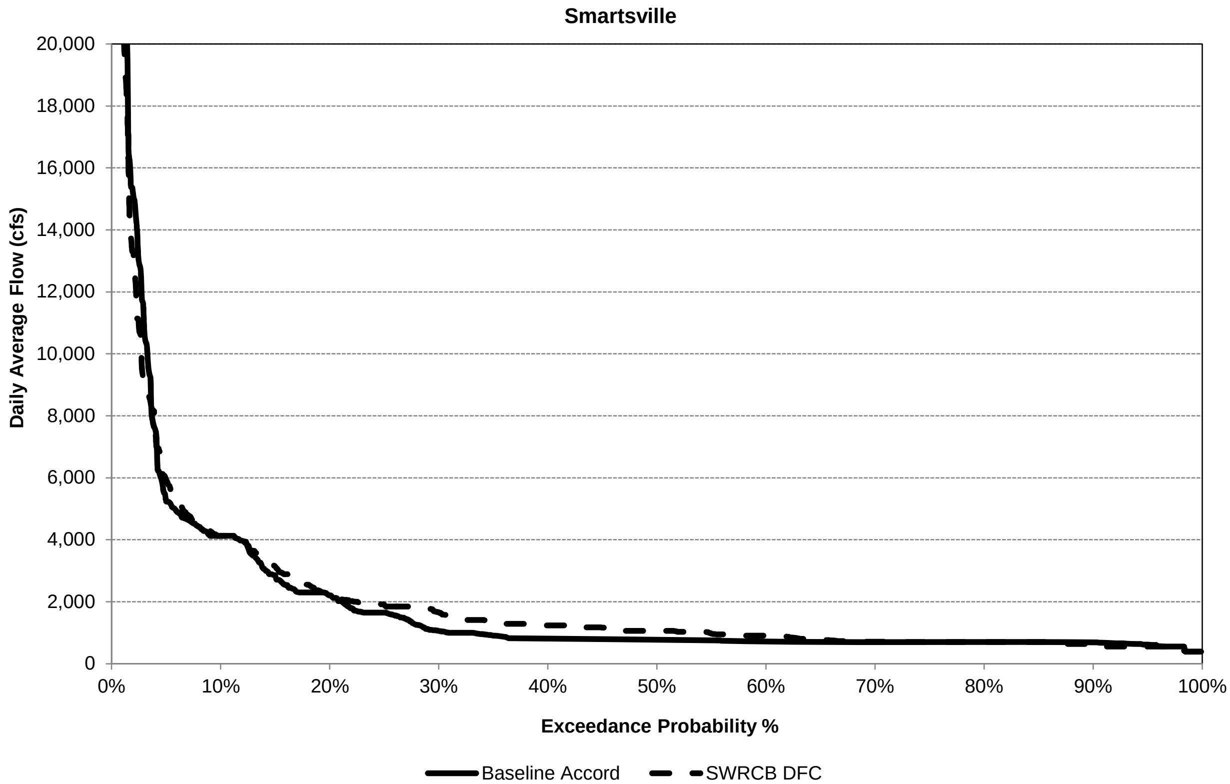


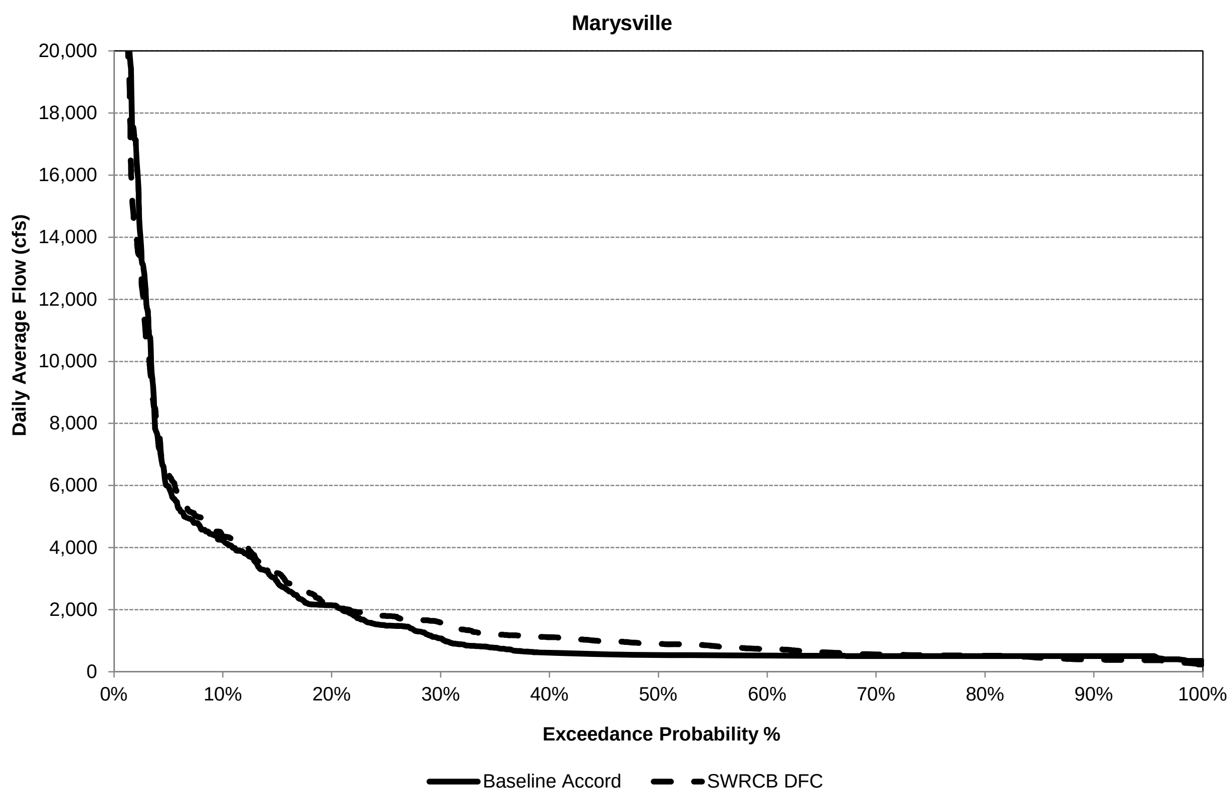



Exceedance Probability of Flow in November
Smartville
Daily Average Flow (cfs)
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance Probability %
Baseline Accord
SWRCB DFC


Marysville
Daily Average Flow (cfs)
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance Probability %
Baseline Accord
SWRCB DFC

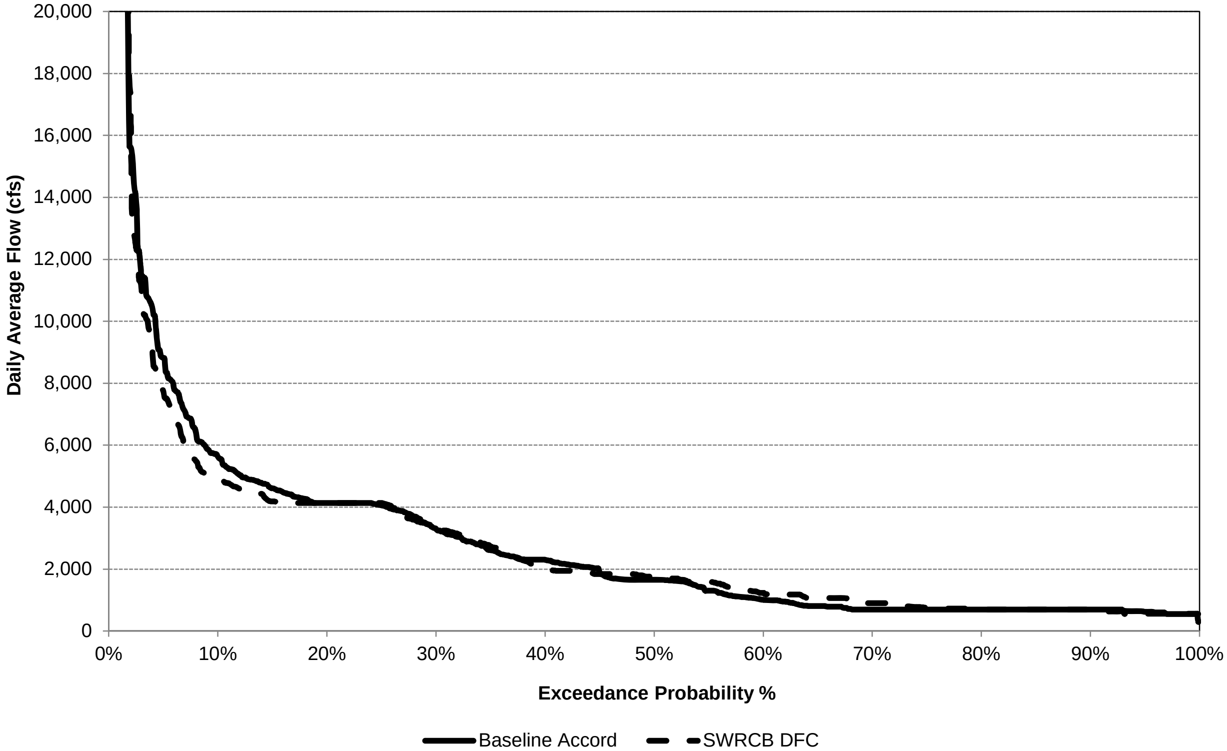
Exceedance Probability of Flow in December



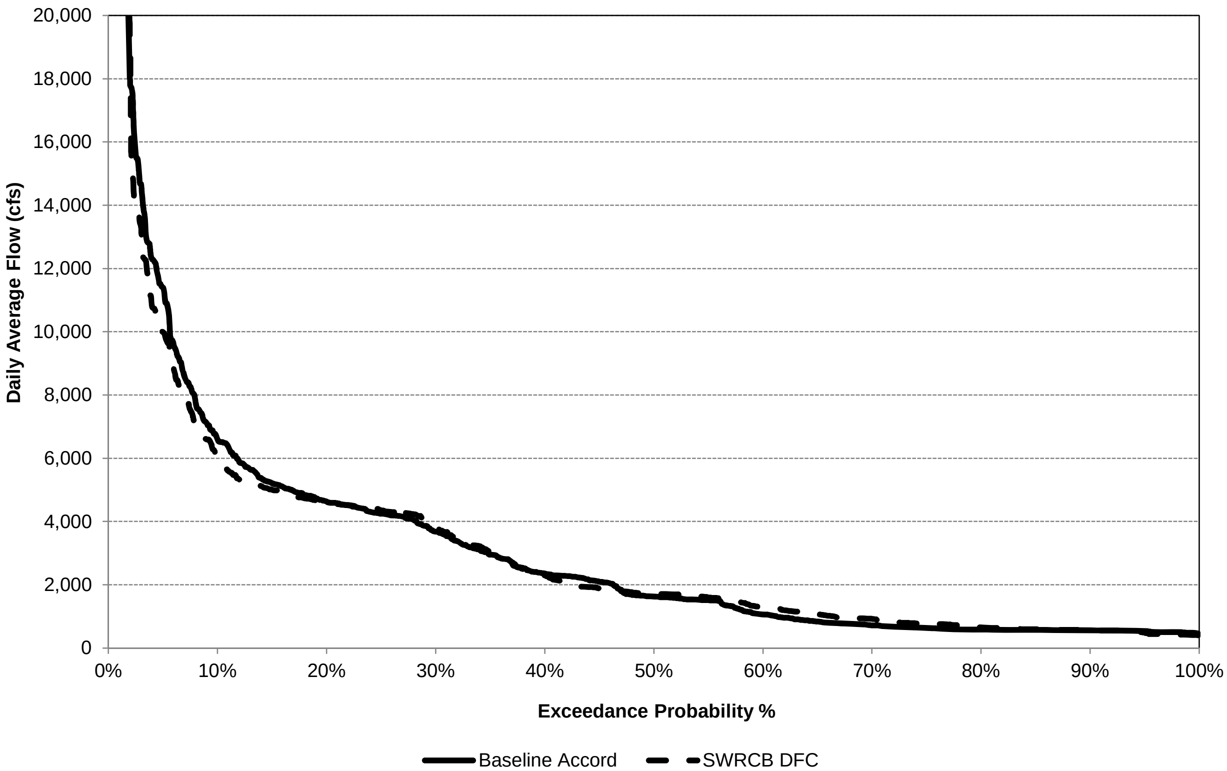


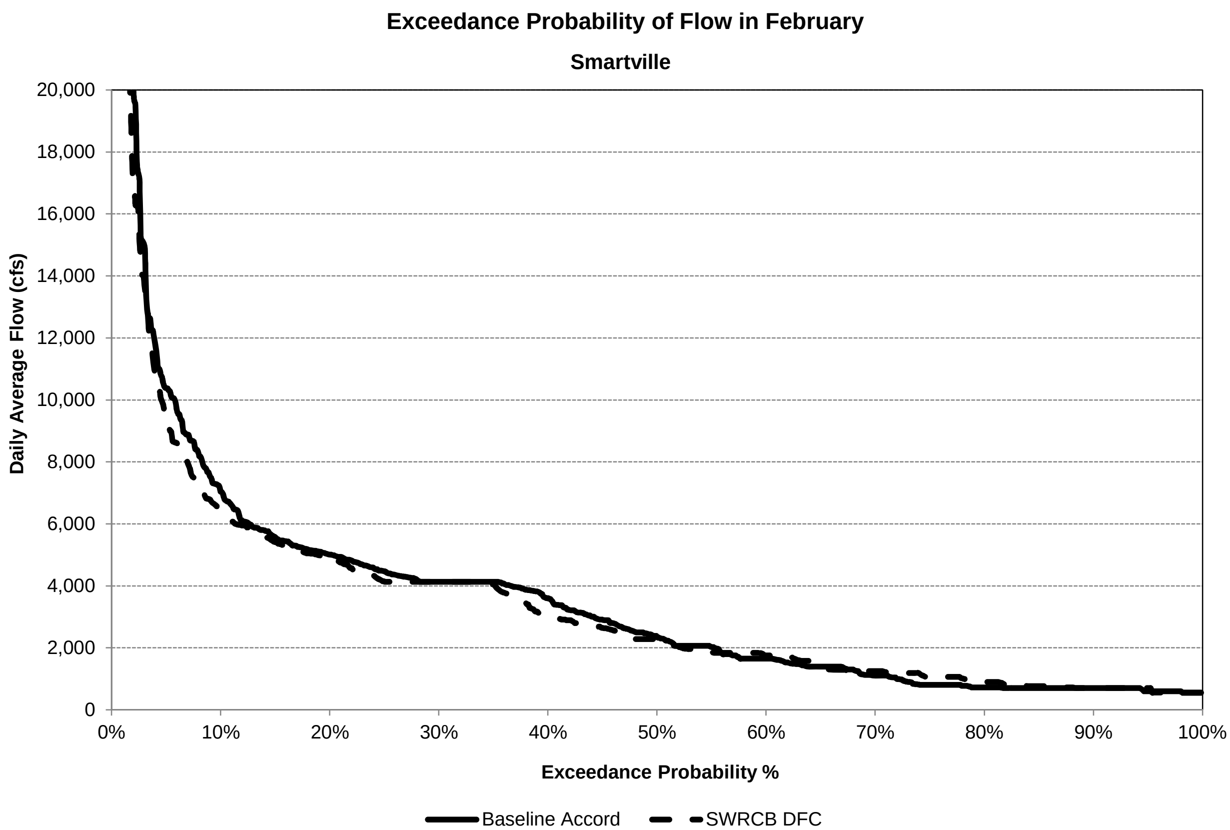
Exceedance Probability of Flow in January

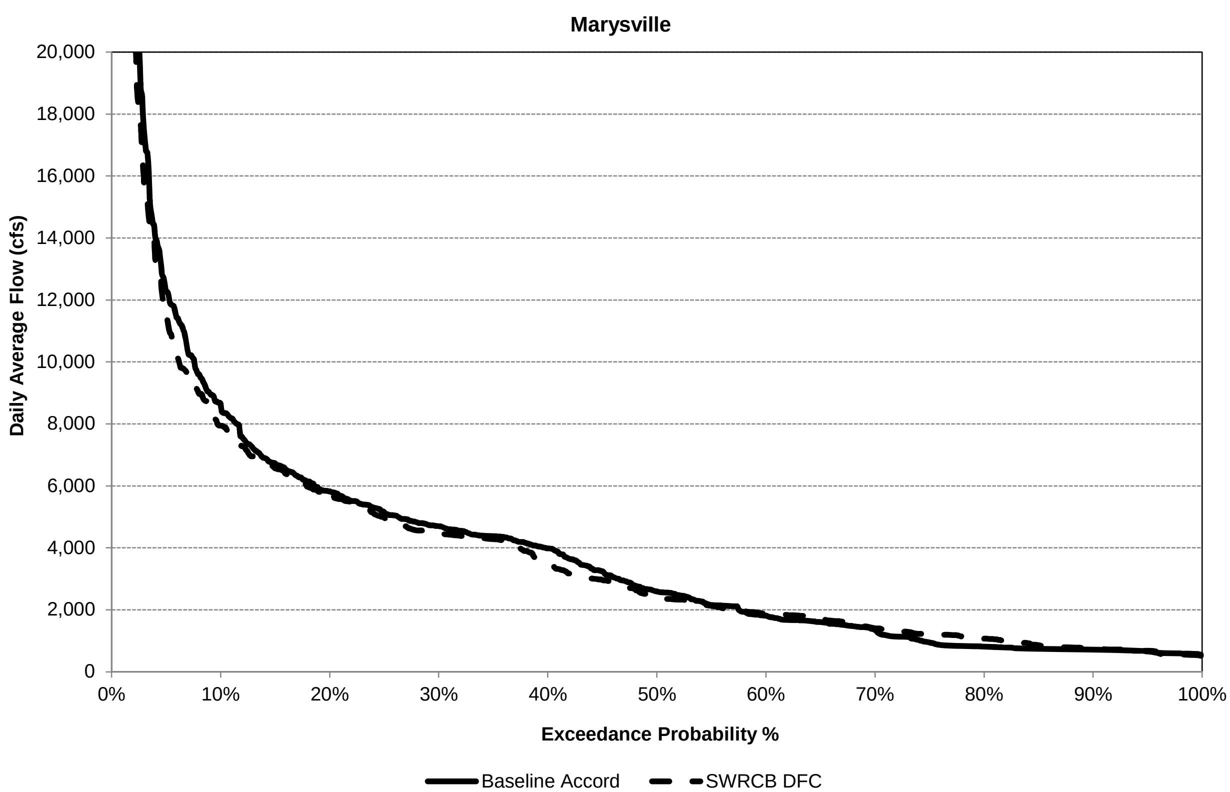
Smartville



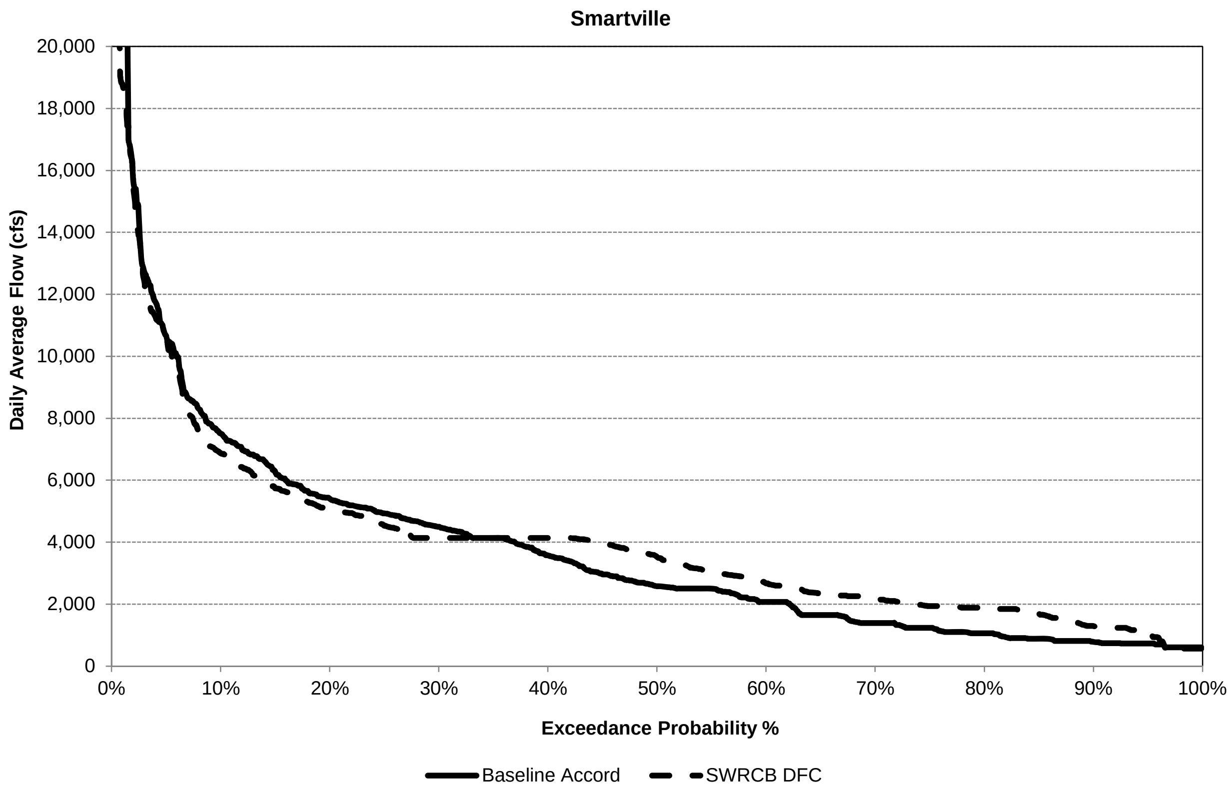
Marysville

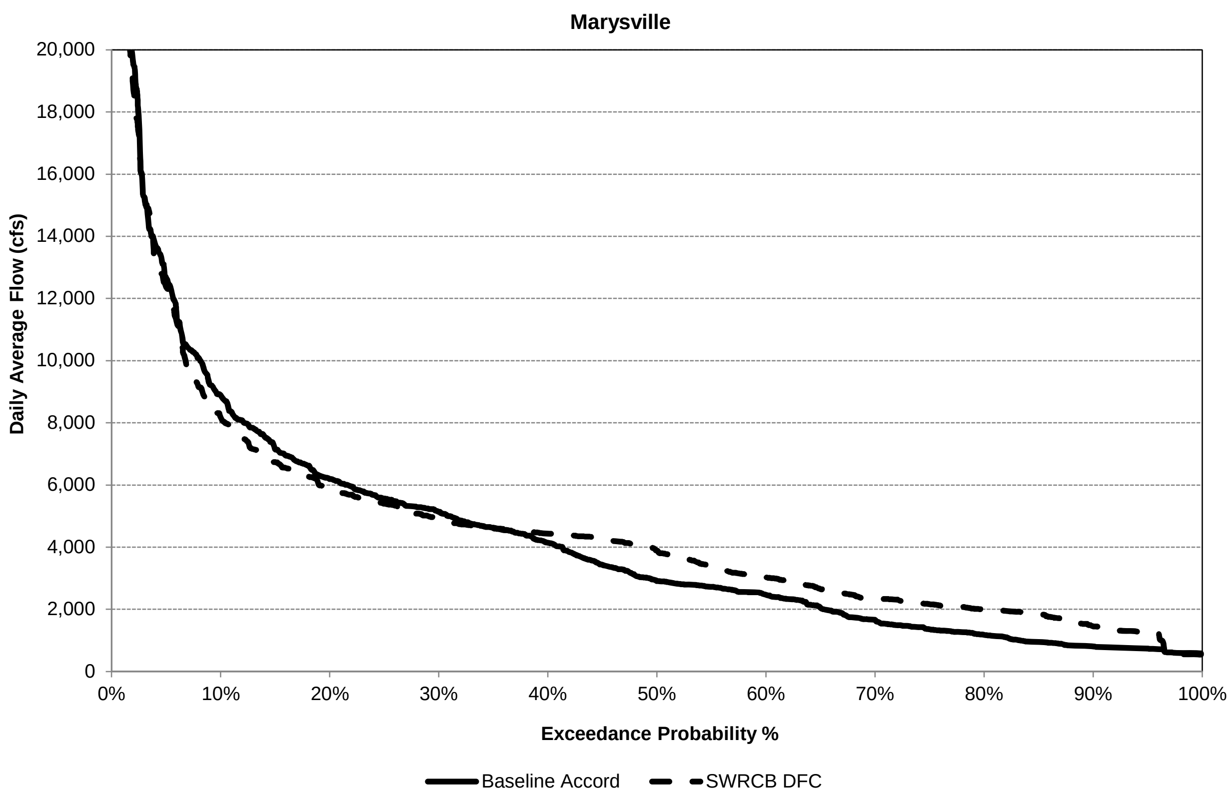


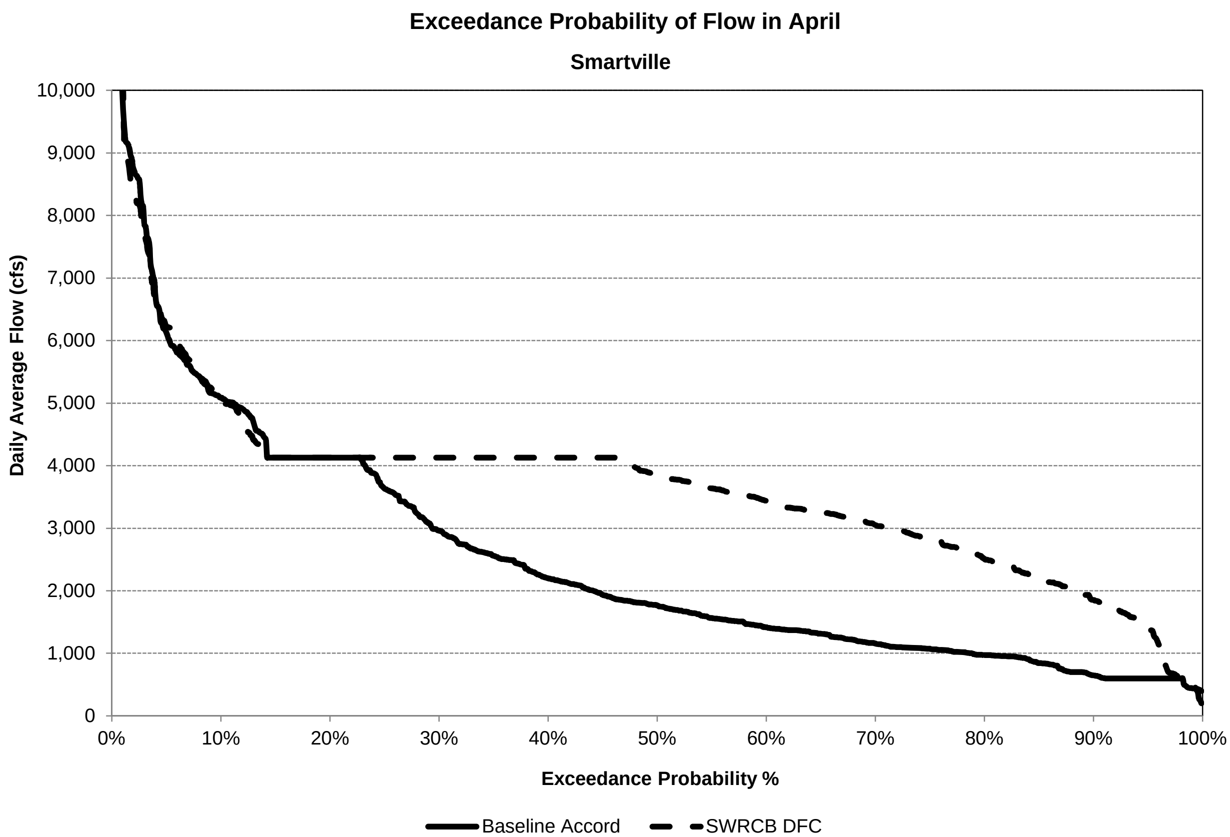

Exceedance Probability of Flow in February
Smartville
Daily Average Flow (cfs)
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance Probability %
Baseline Accord
SWRCB DFC

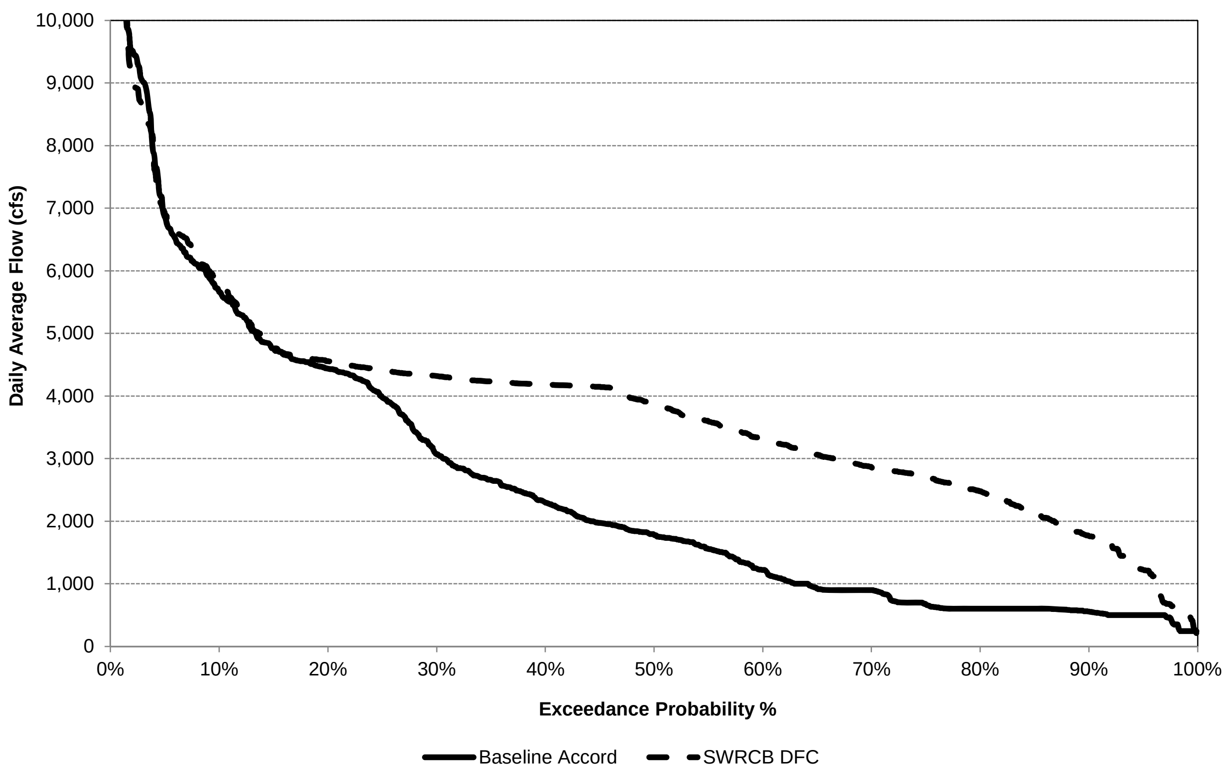

Marysville
Daily Average Flow (cfs)
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance Probability %
Baseline Accord
SWRCB DFC

Exceedance Probability of Flow in March

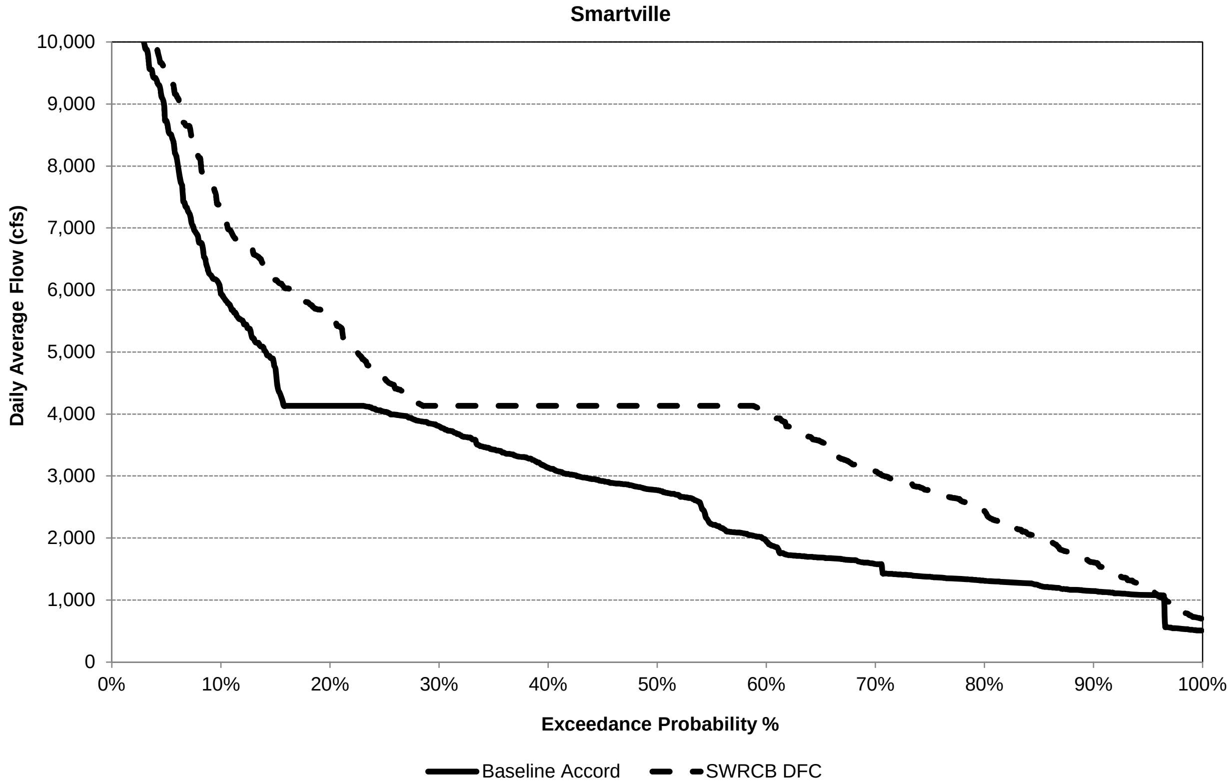


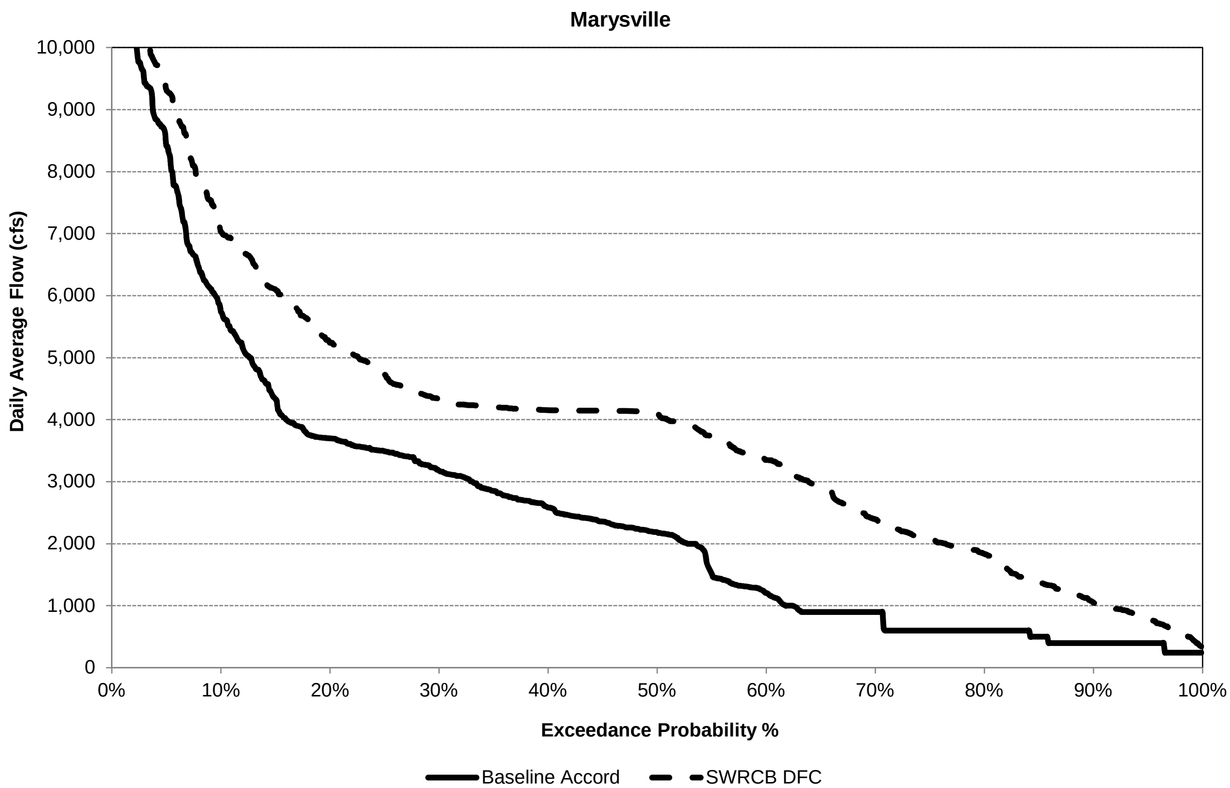



Exceedance Probability of Flow in April
Smartville
Daily Average Flow (cfs)
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance Probability %
Baseline Accord
SWRCB DFC

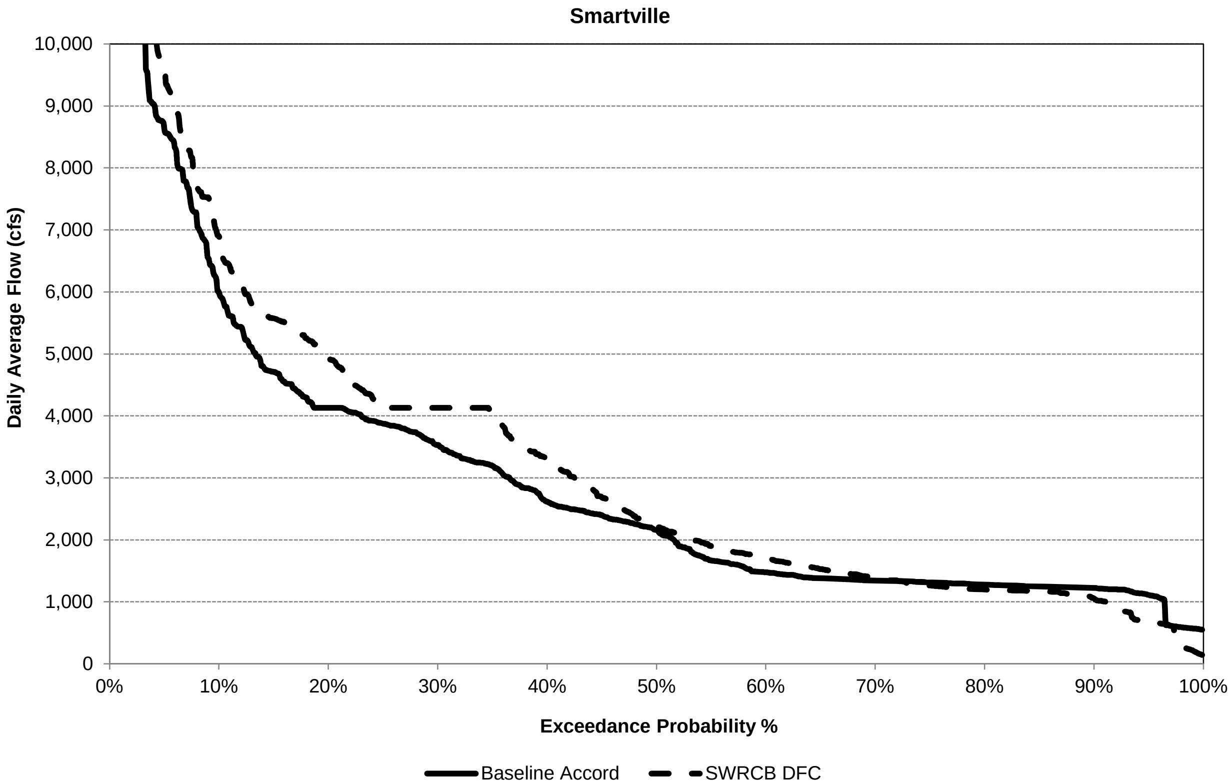

Daily Average Flow (cfs)
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance Probability %
Baseline Accord
SWRCB DFC

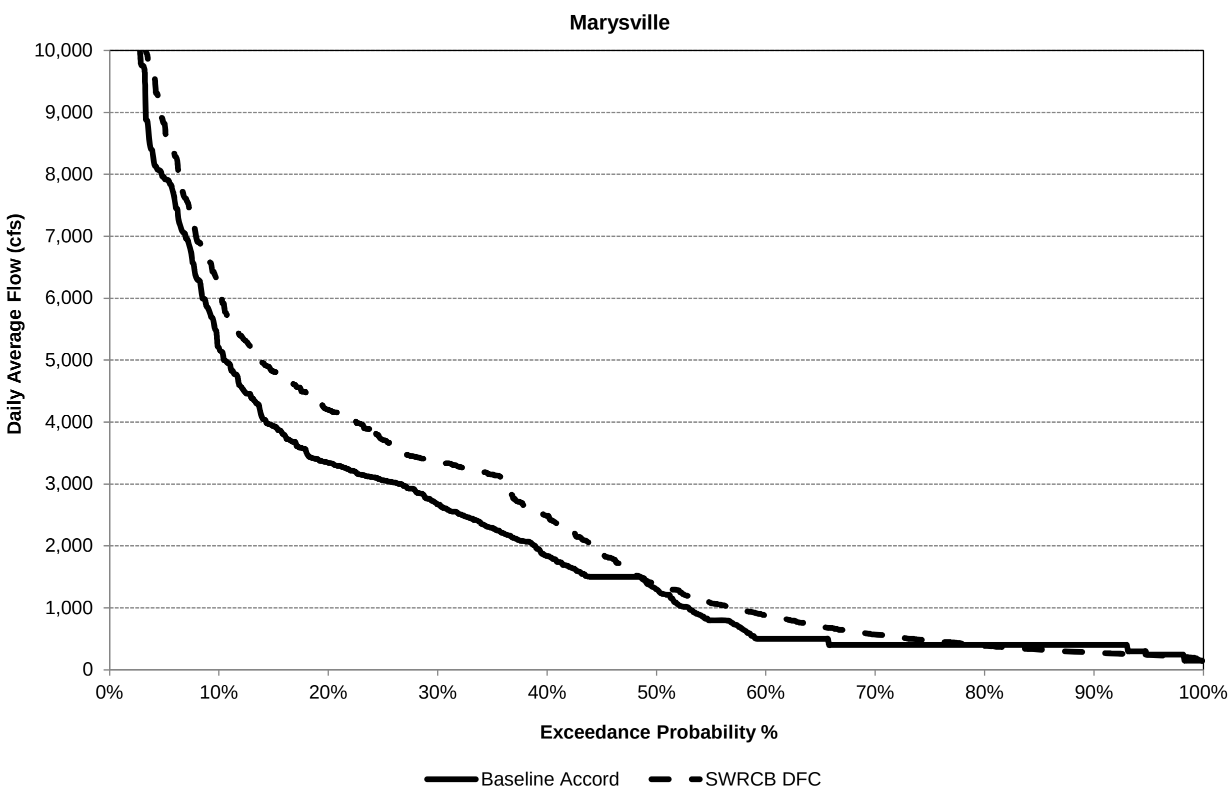
Exceedance Probability of Flow in May

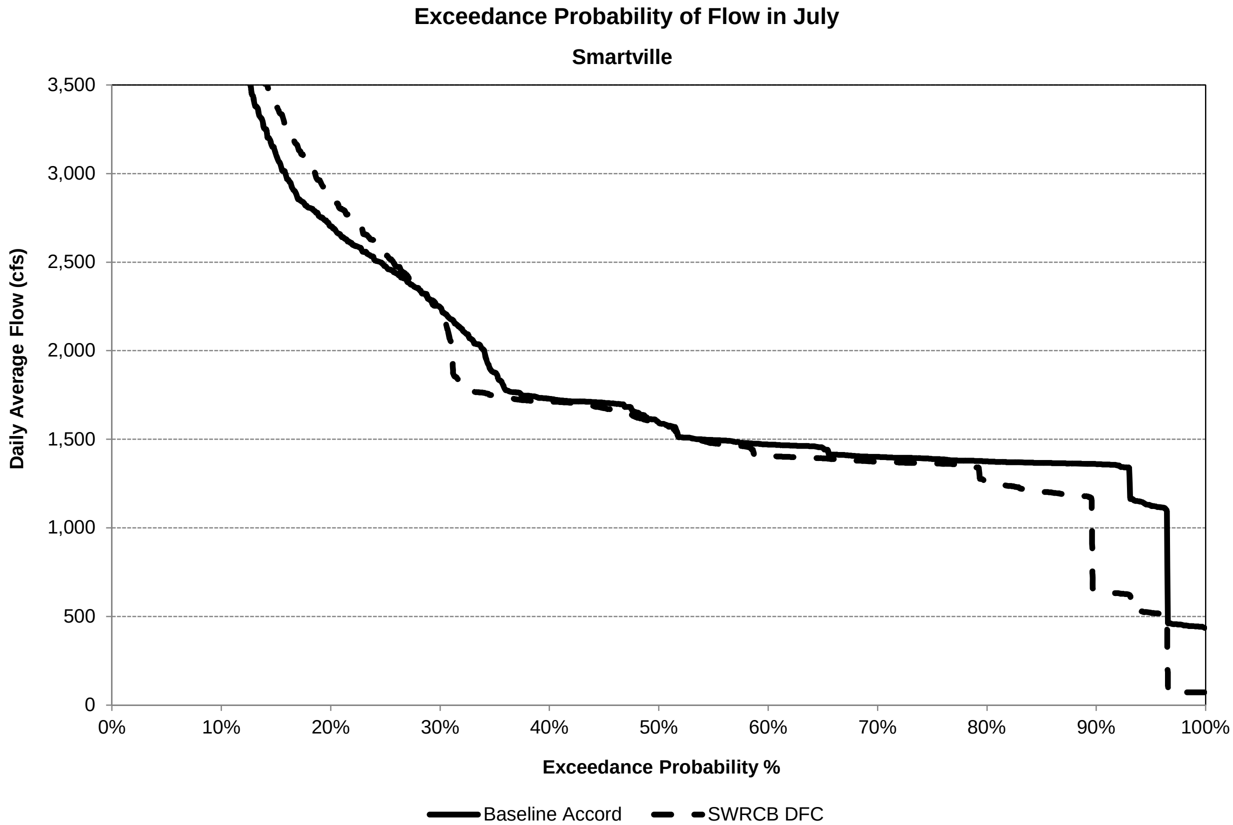


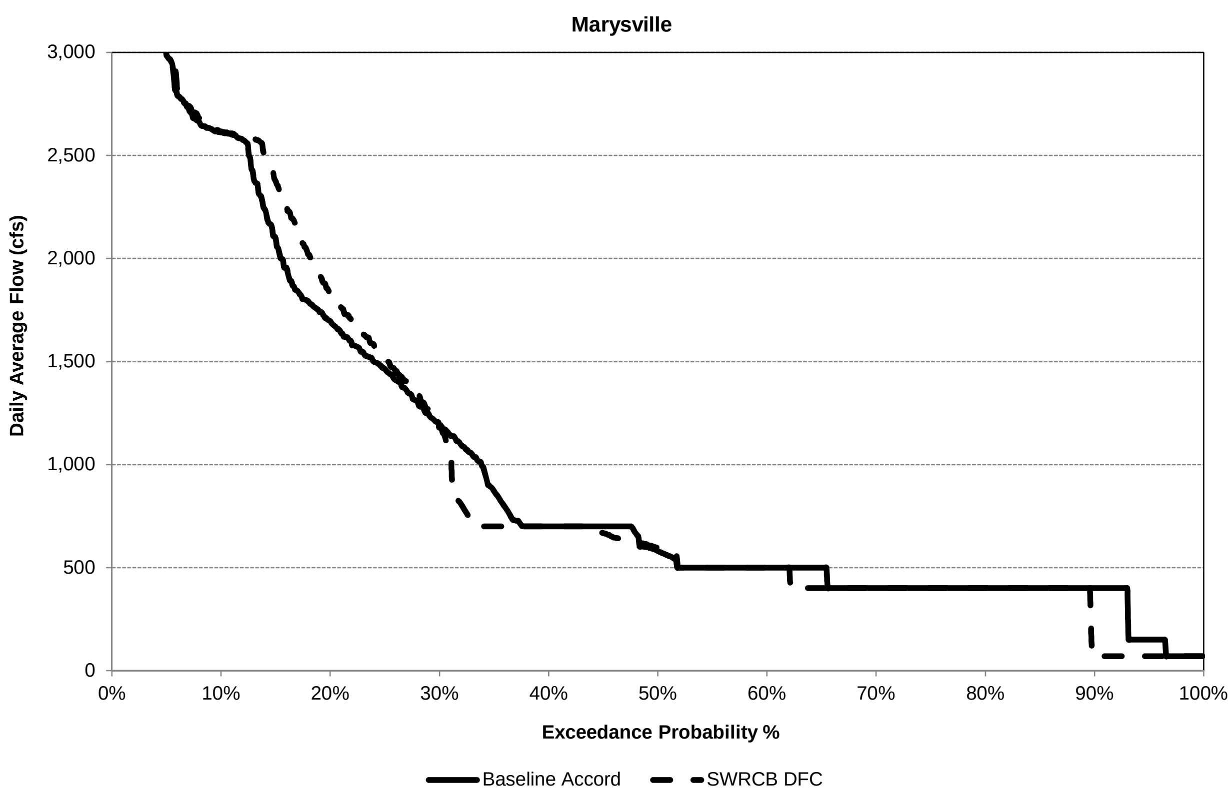


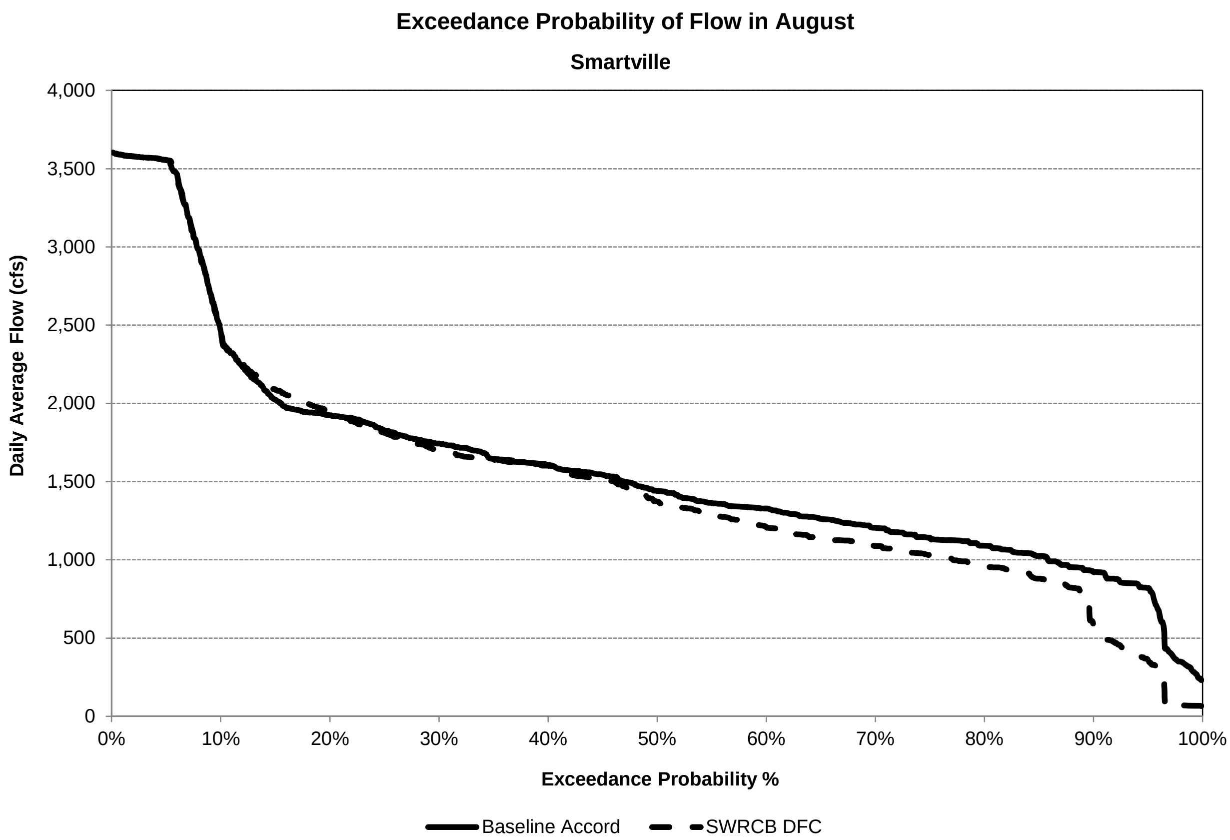
Exceedance Probability of Flow in June

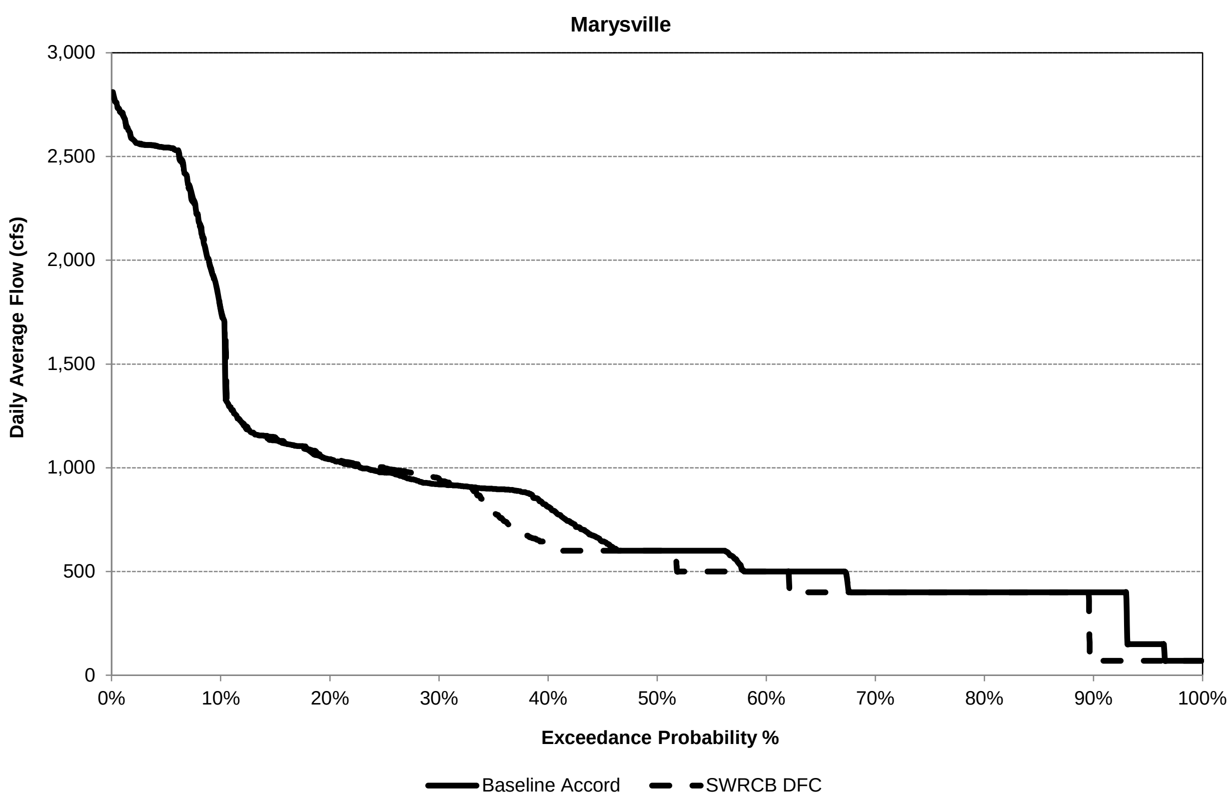




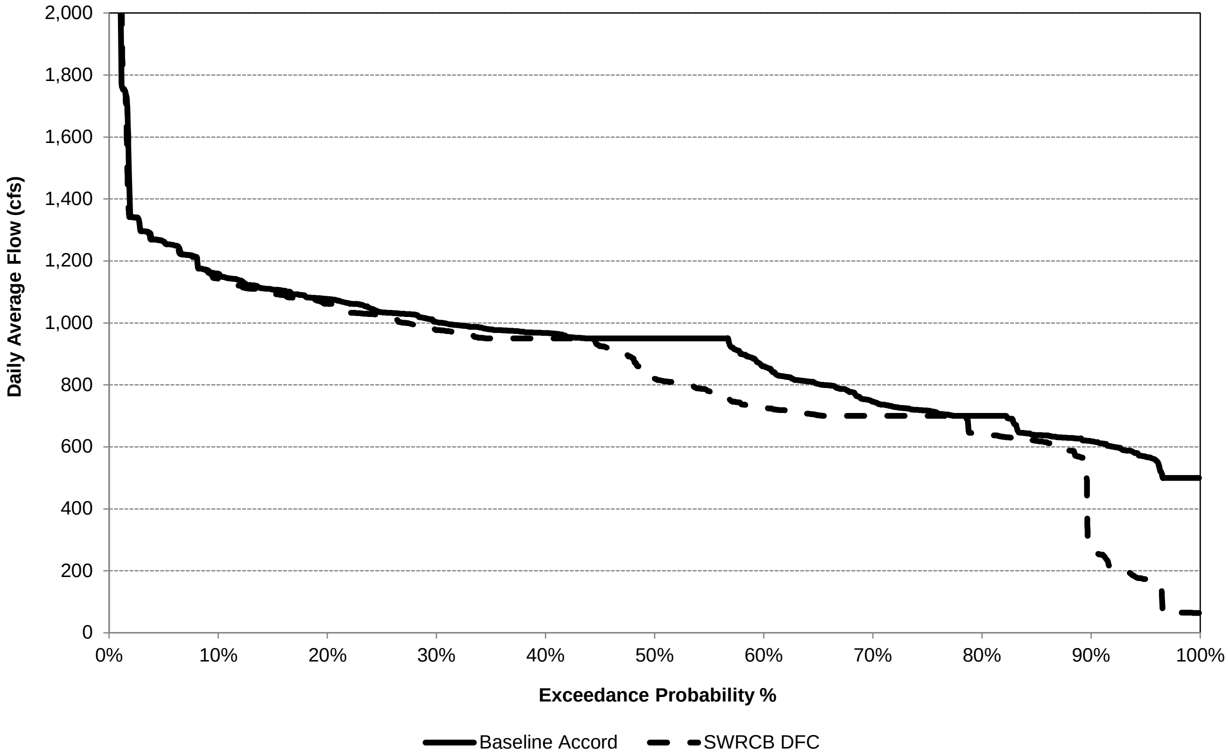

Exceedance Probability of Flow in July
Smartville
Daily Average Flow (cfs)
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance Probability %
Baseline Accord
SWRCB DFC


Marysville
Daily Average Flow (cfs)
3,000
2,500
2,000
1,500
1,000
500
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance Probability %
Baseline Accord
SWRCB DFC

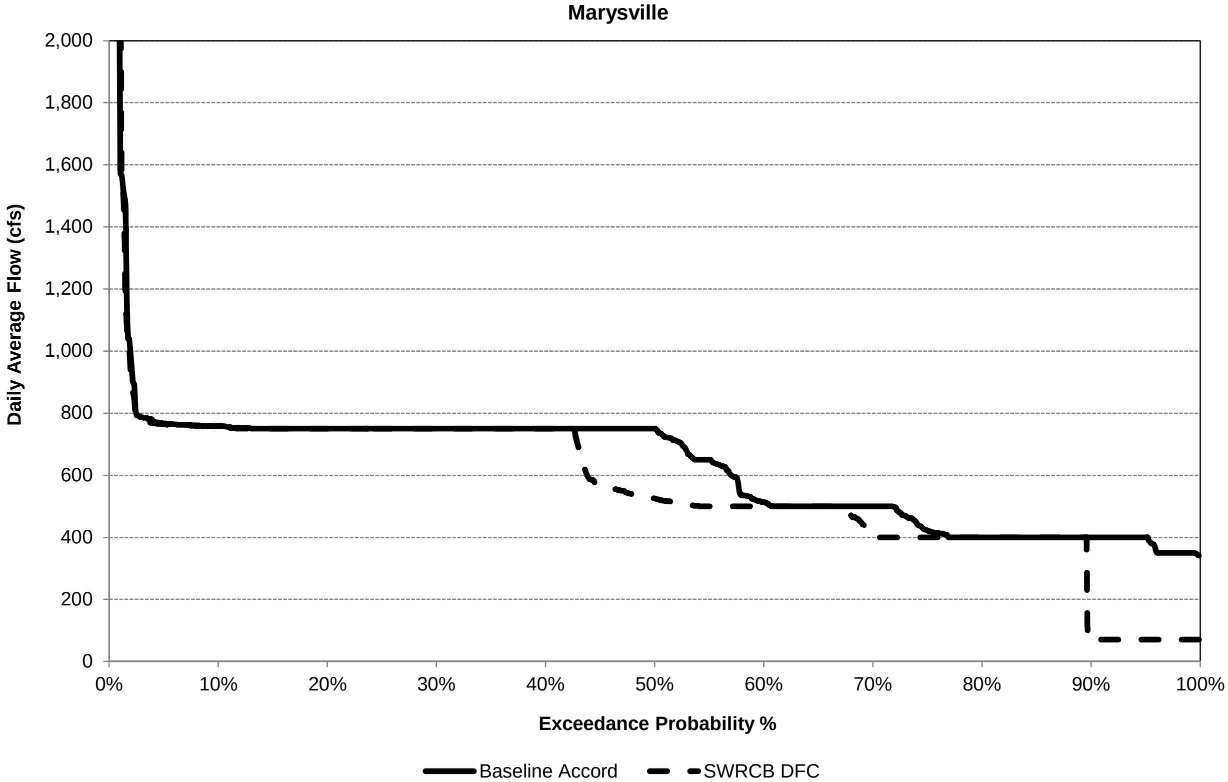

Exceedance Probability of Flow in August
Smartville
Daily Average Flow (cfs)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance Probability %
Baseline Accord
SWRCB DFC


Marysville
Daily Average Flow (cfs)
3,000
2,500
2,000
1,500
1,000
500
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance Probability %
Baseline Accord
SWRCB DFC

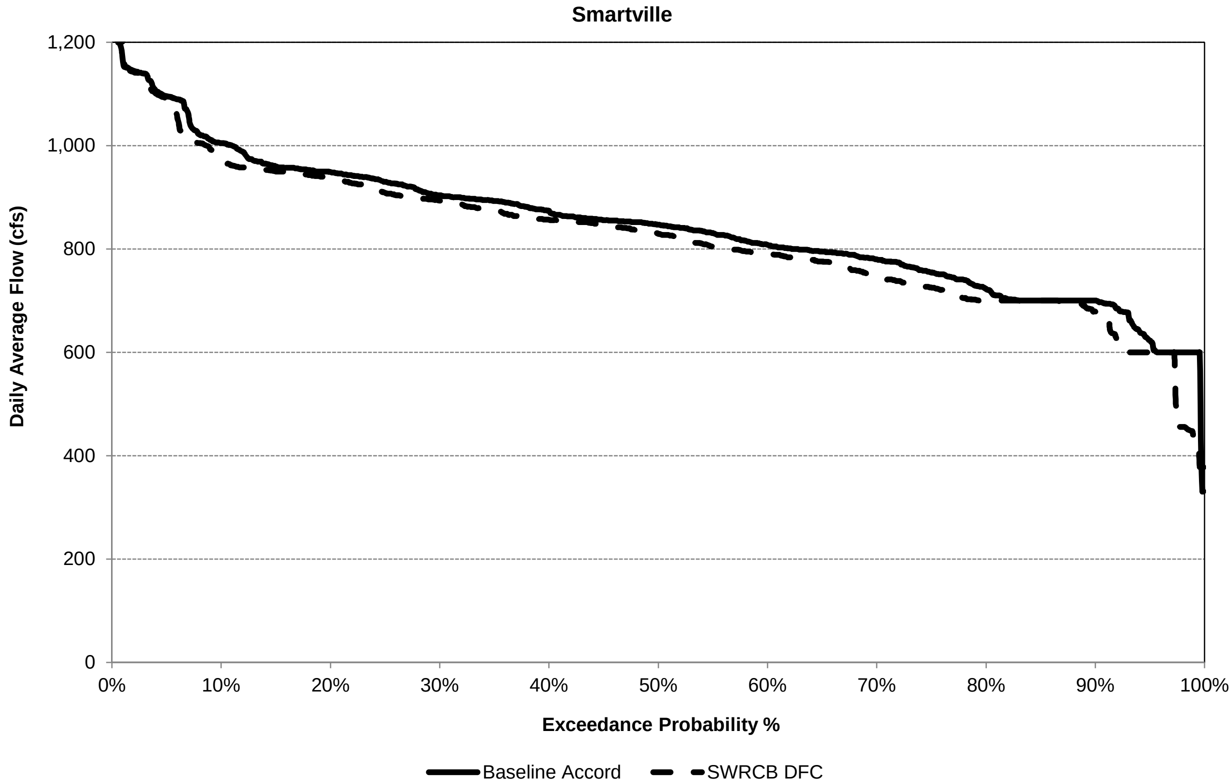
Exceedance Probability of Flow in September

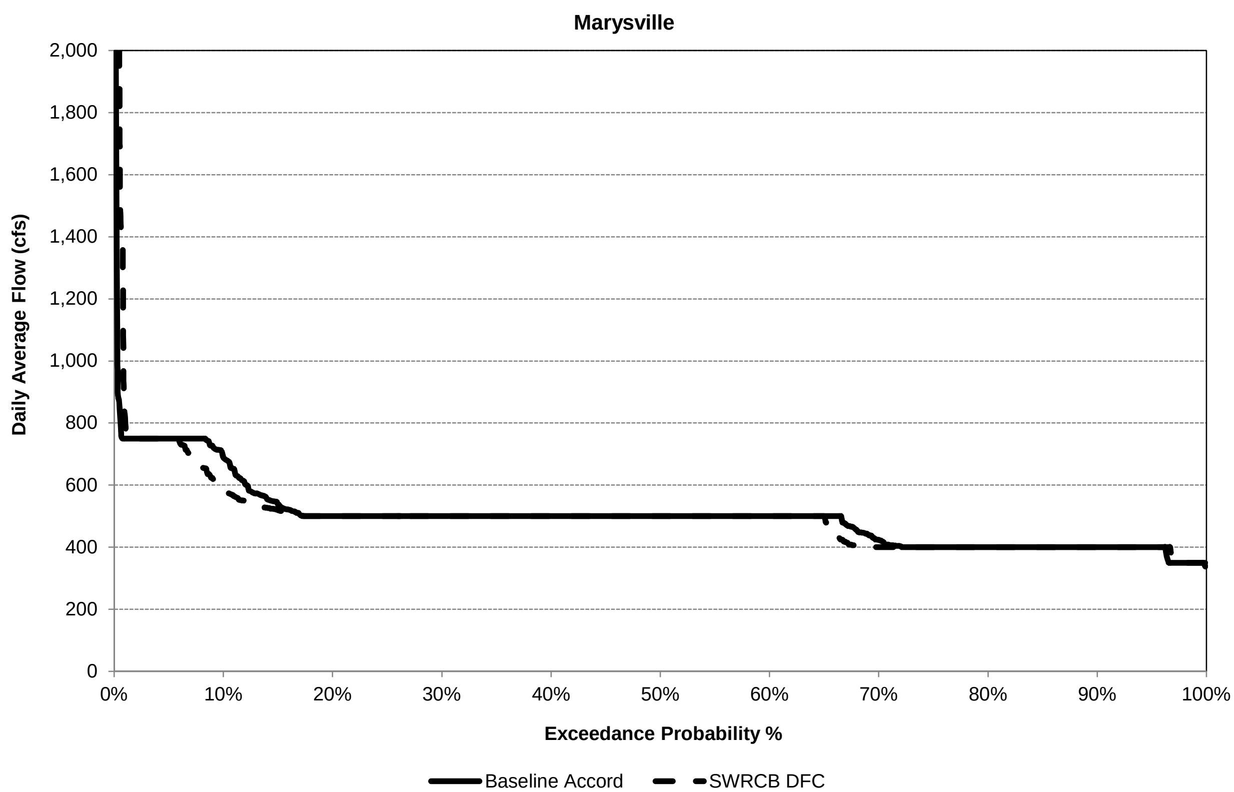


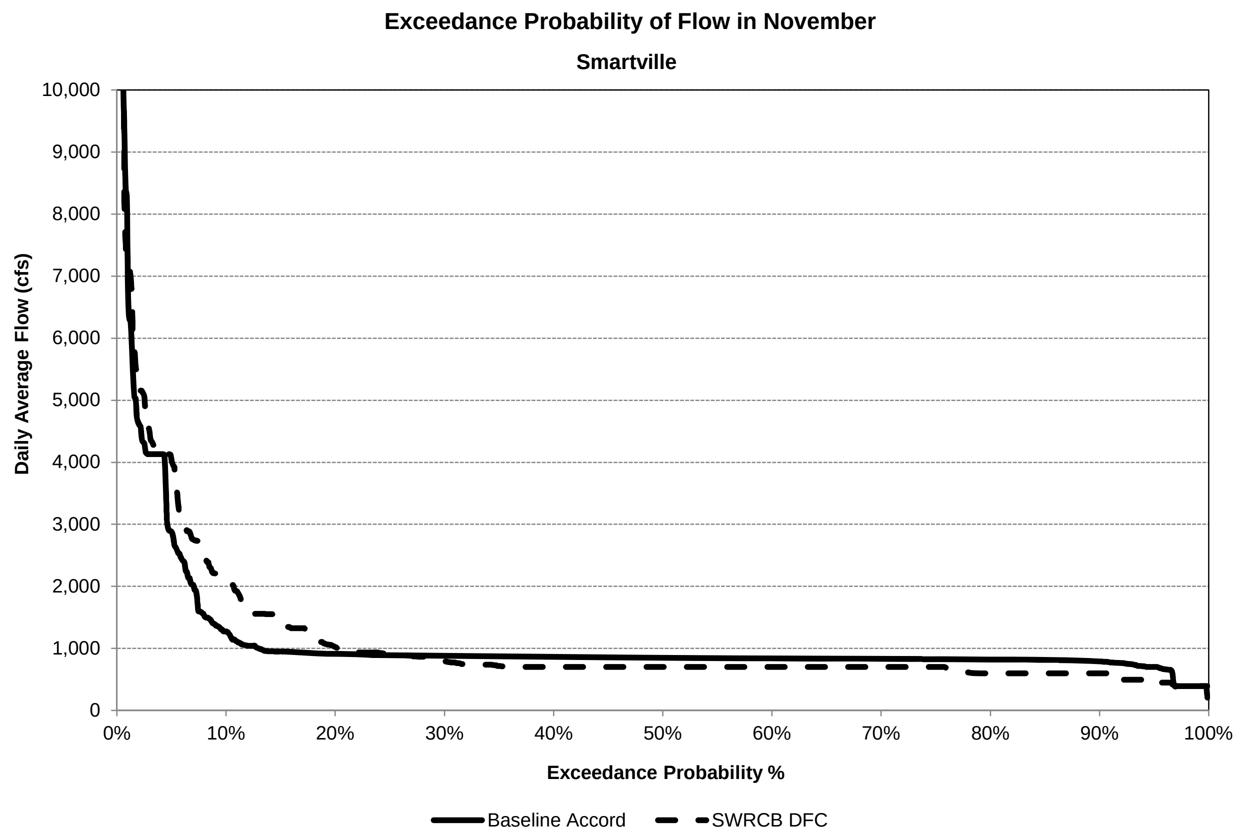
Marysville

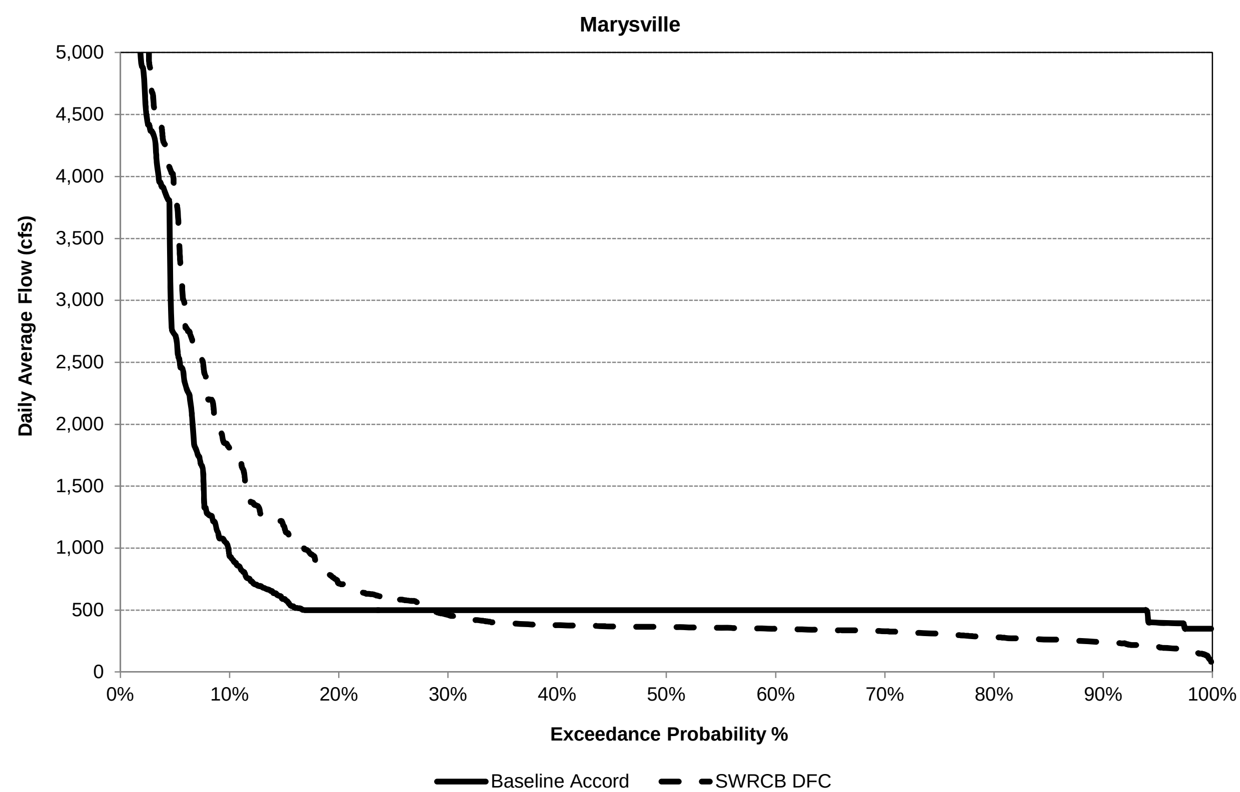


Exceedance Probability of Flow in October

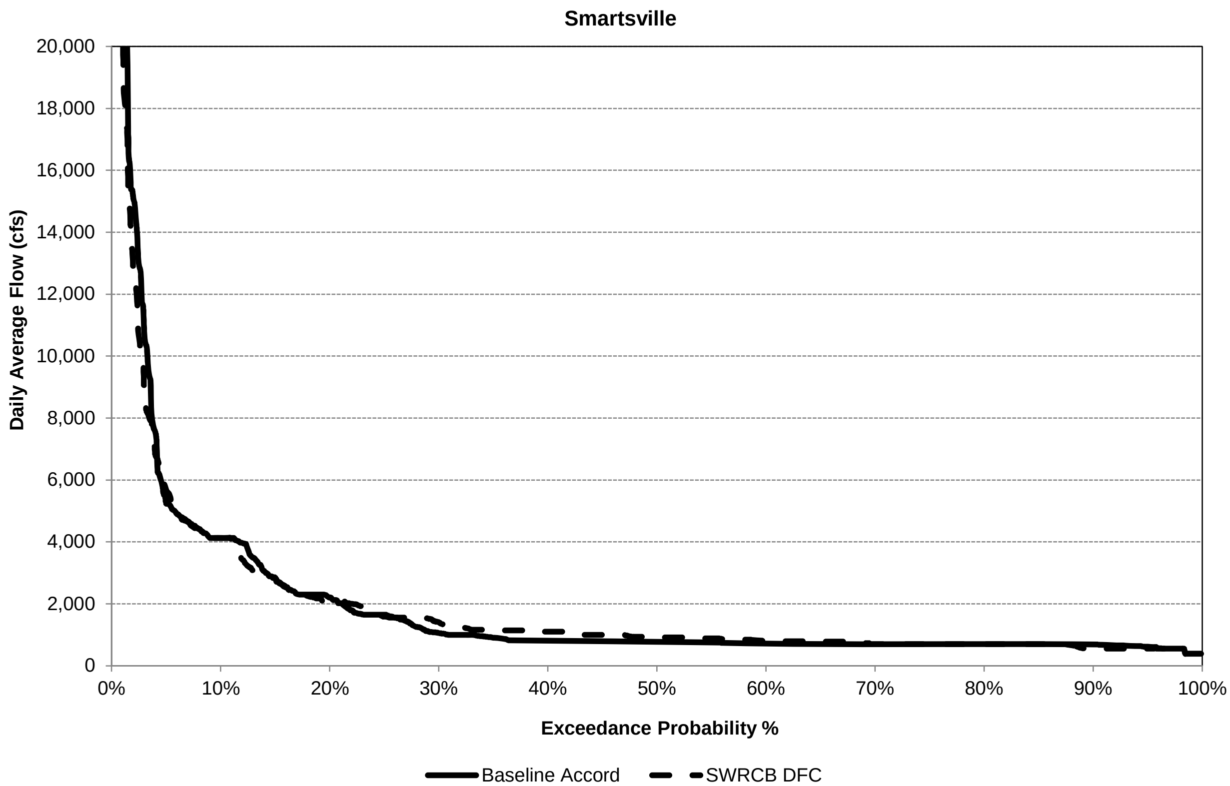


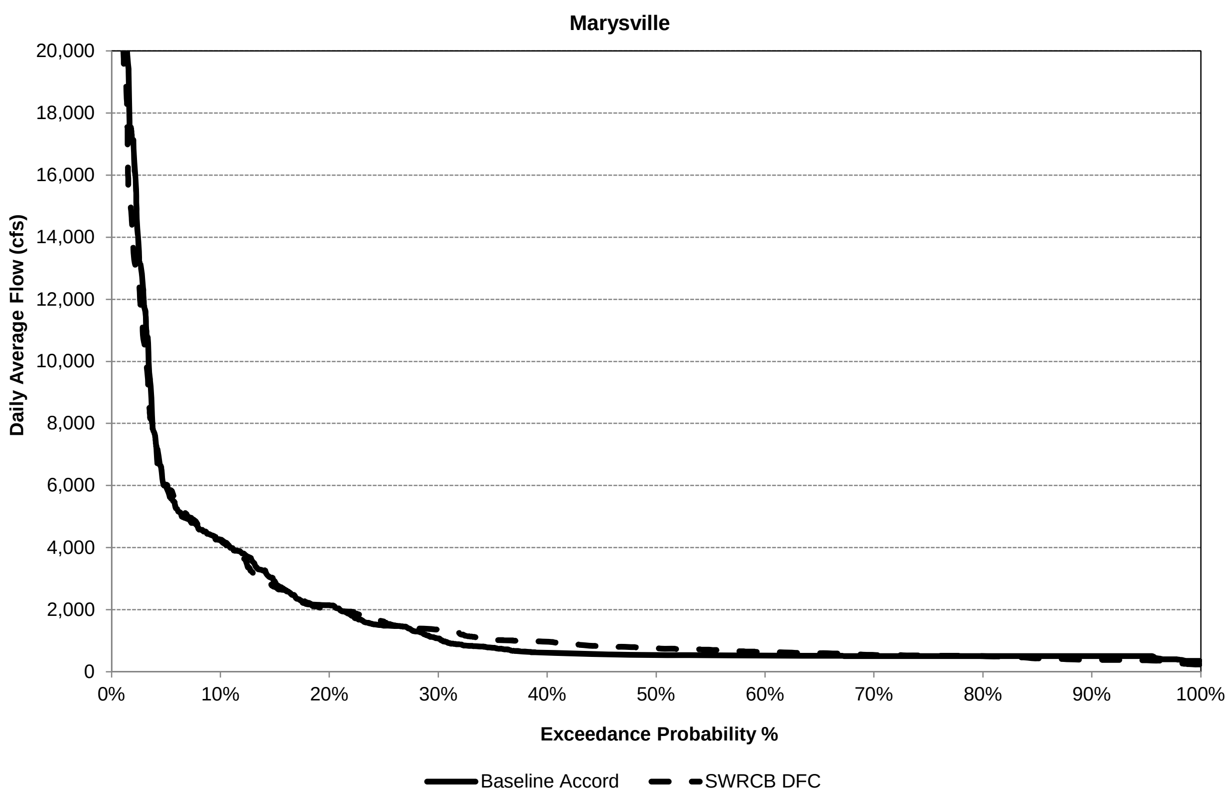



Exceedance Probability of Flow in November
Smartville
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
Daily Average Flow (cfs)
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance Probability %
Baseline Accord
SWRCB DFC

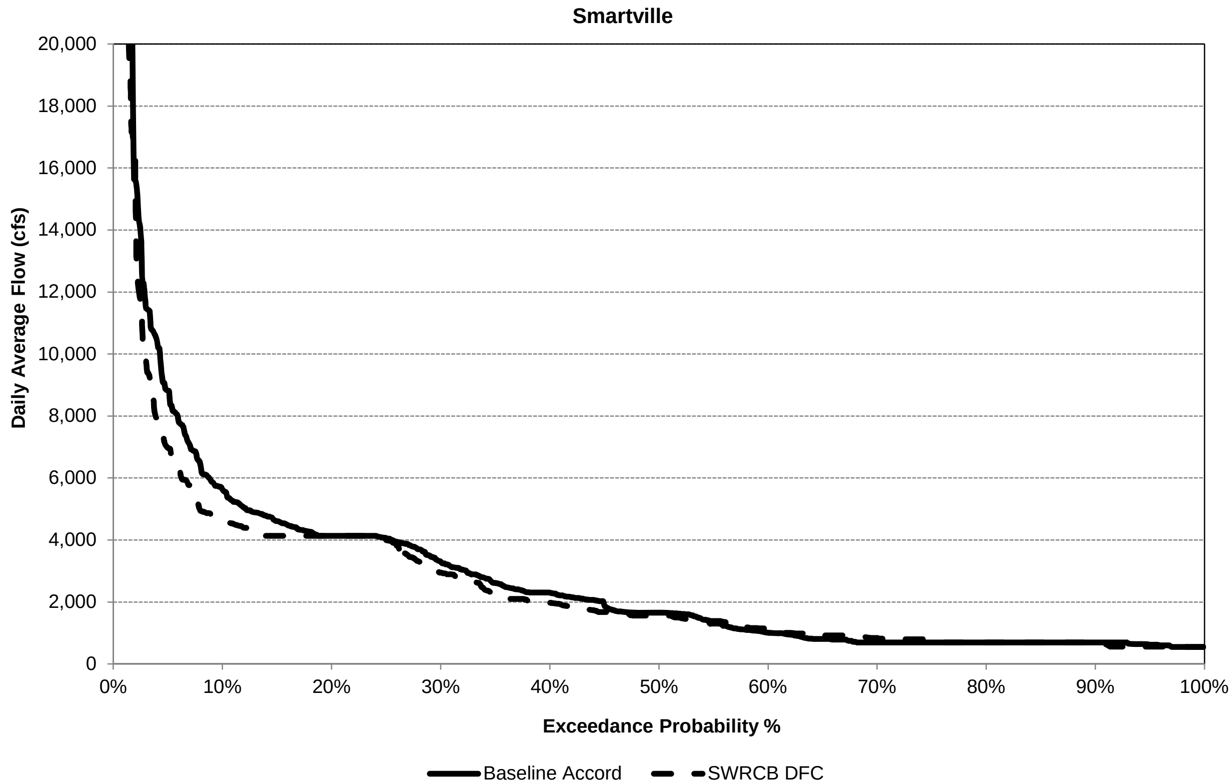

Marysville
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Daily Average Flow (cfs)
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance Probability %
Baseline Accord
SWRCB DFC

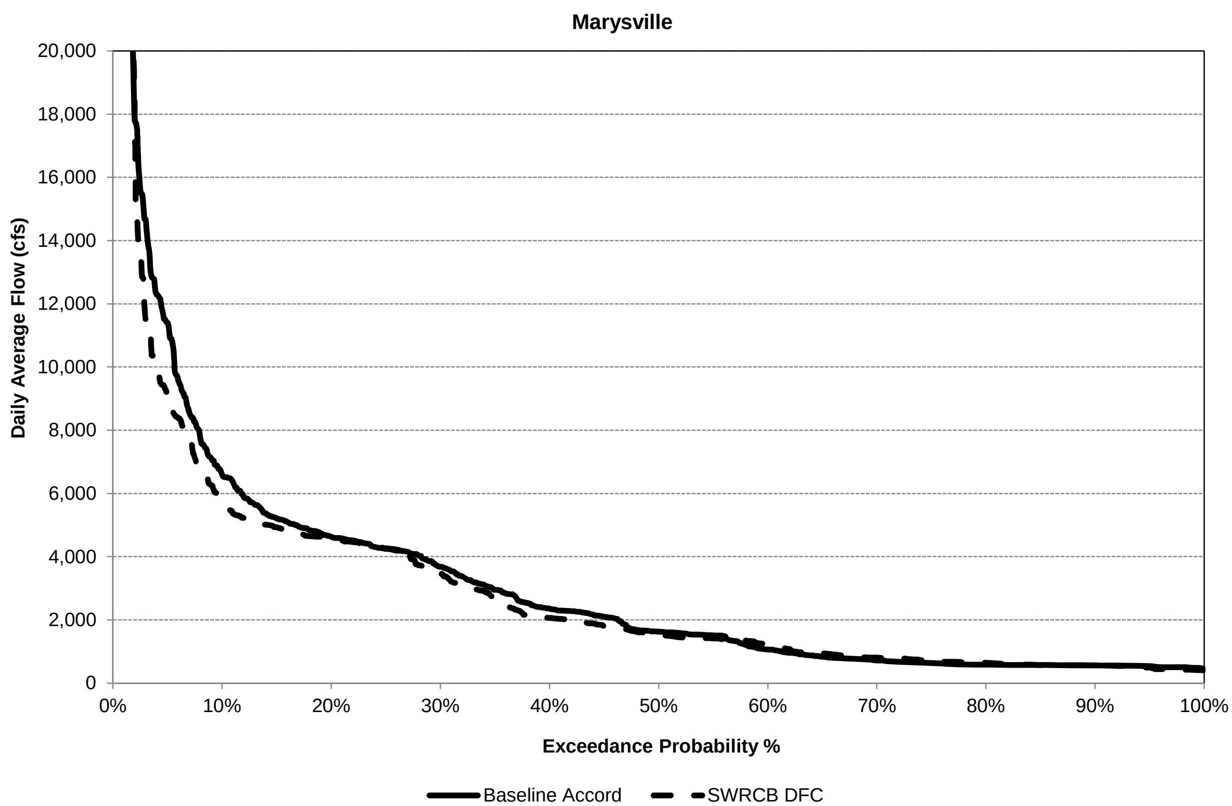
Exceedance Probability of Flow in December



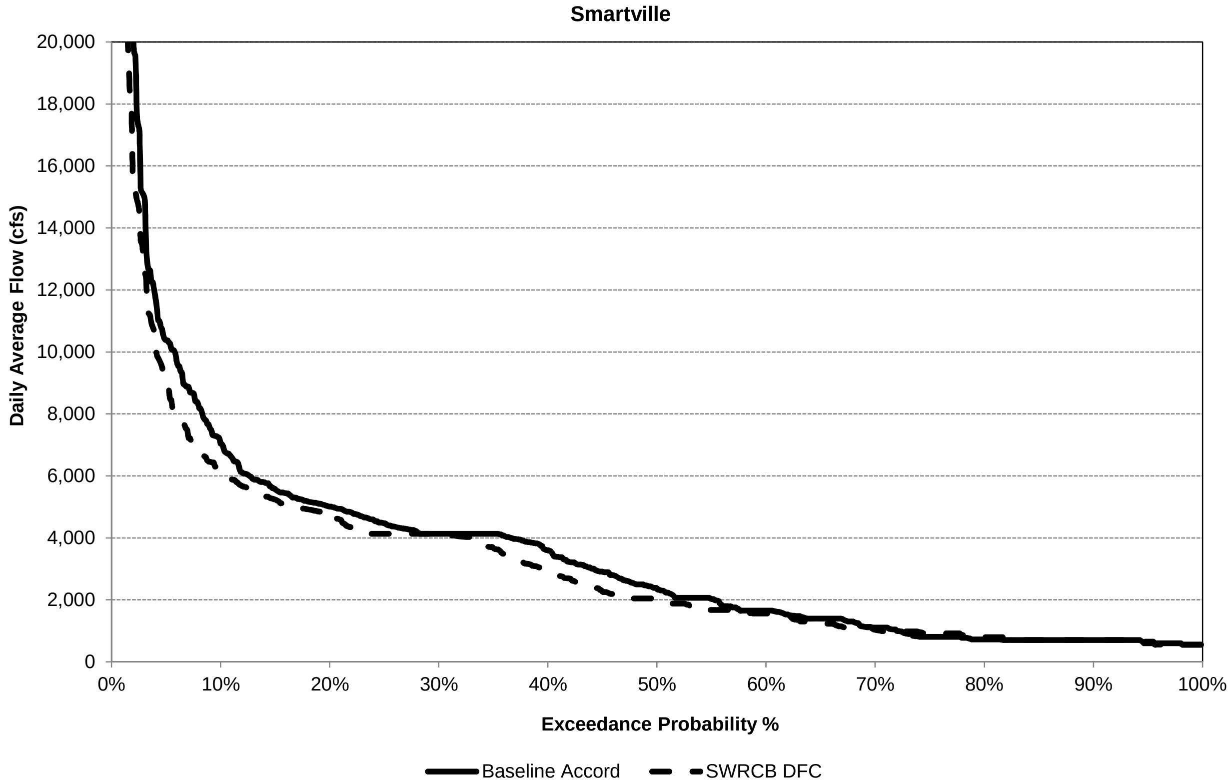


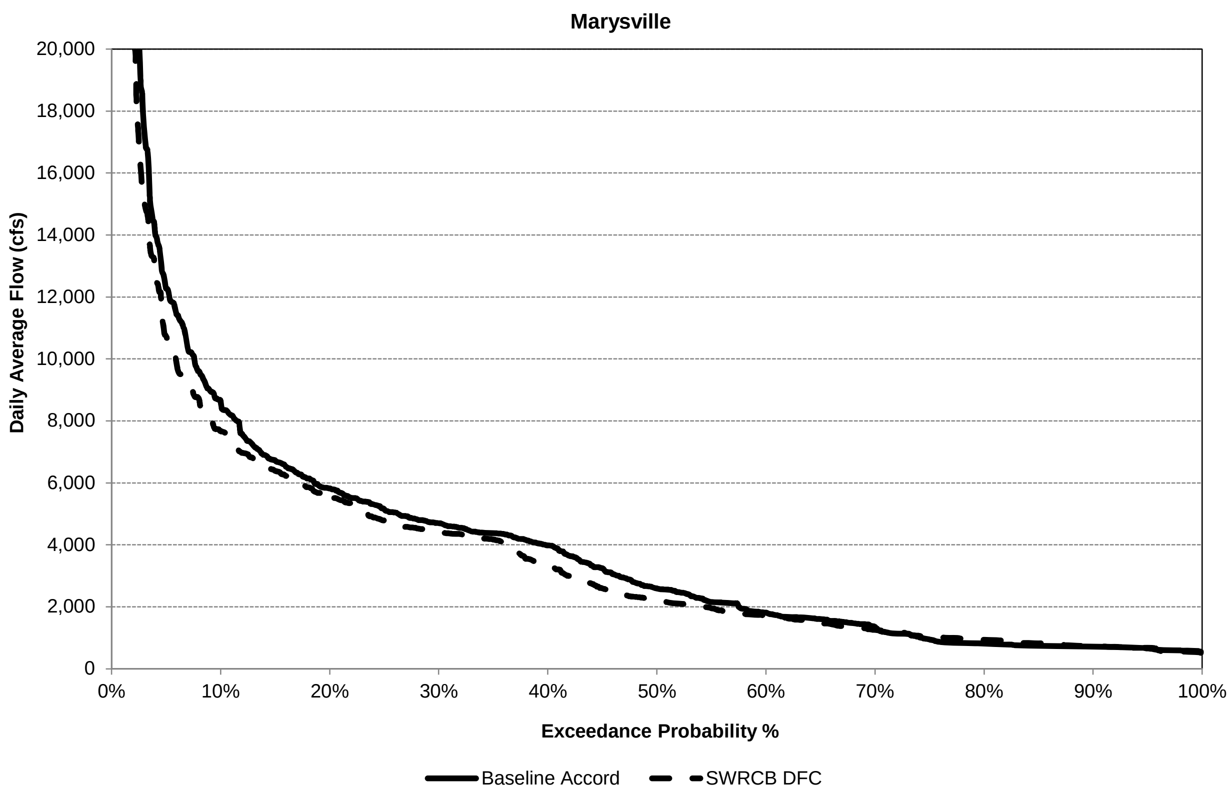
Exceedance Probability of Flow in January

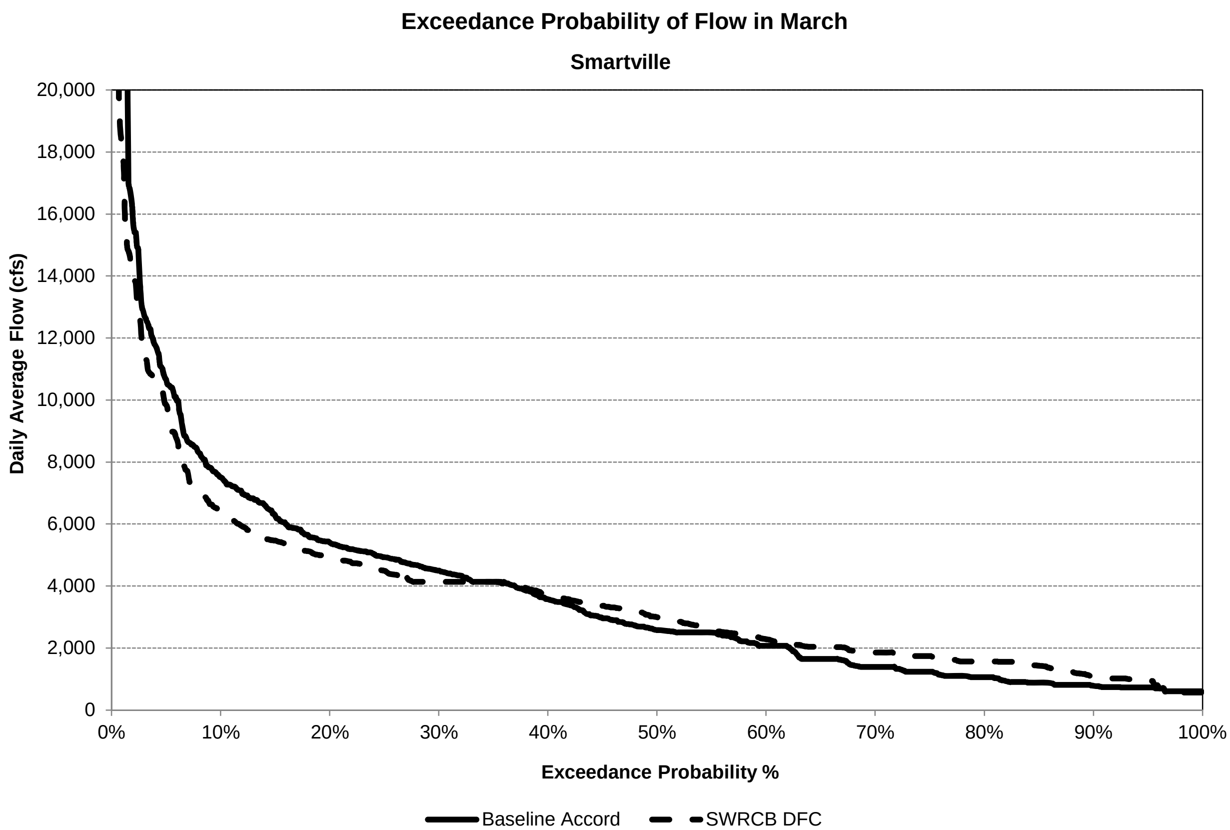


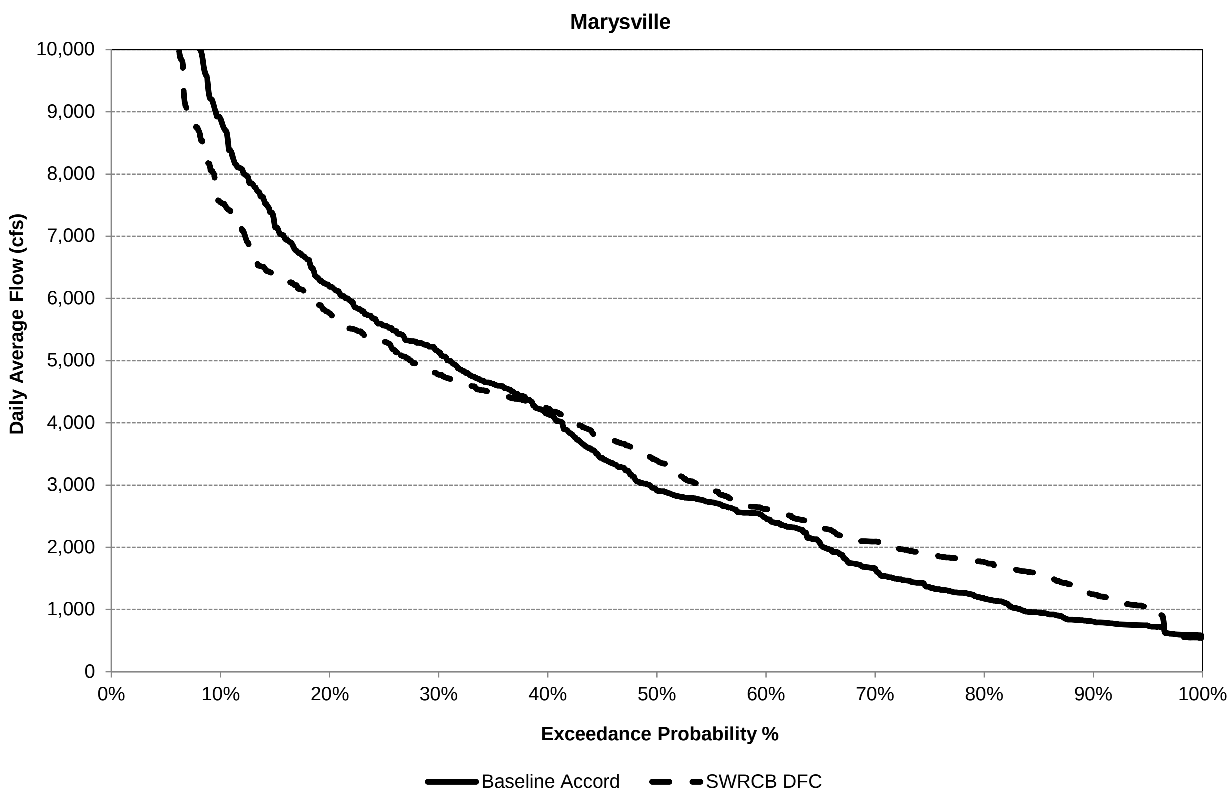


Exceedance Probability of Flow in February

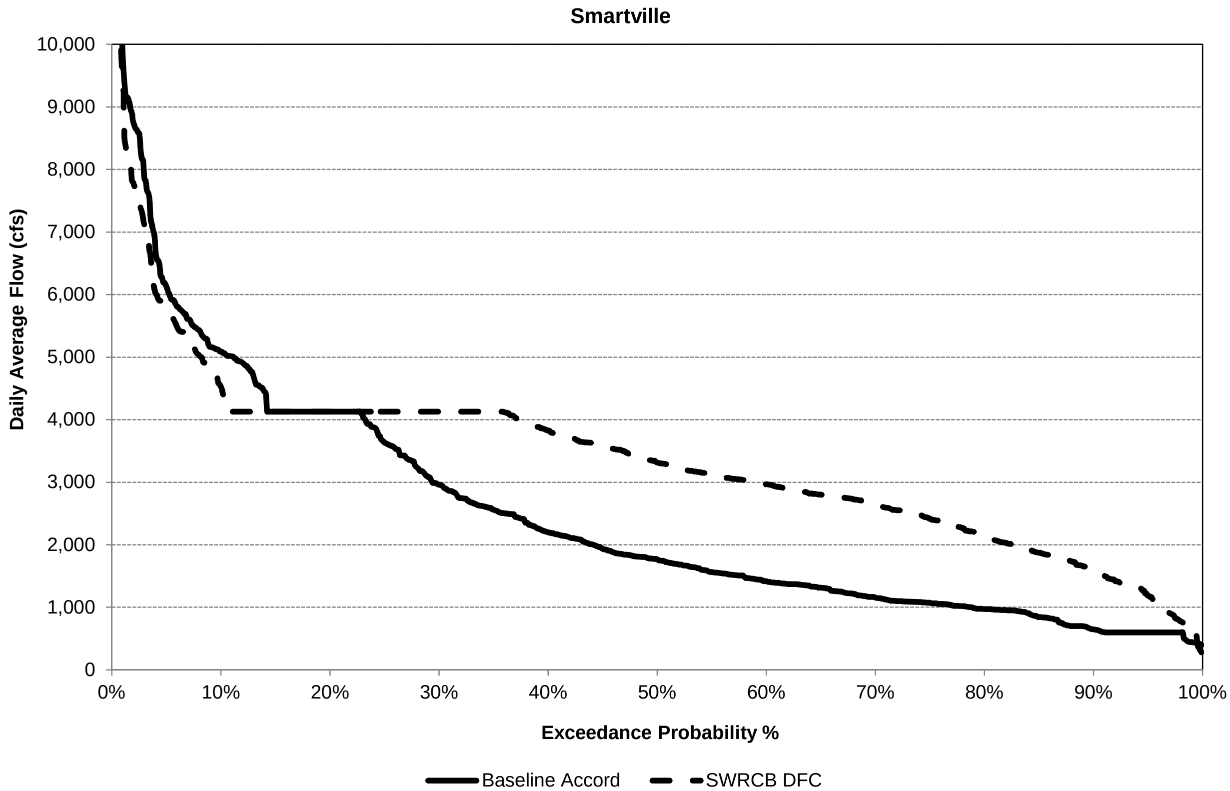


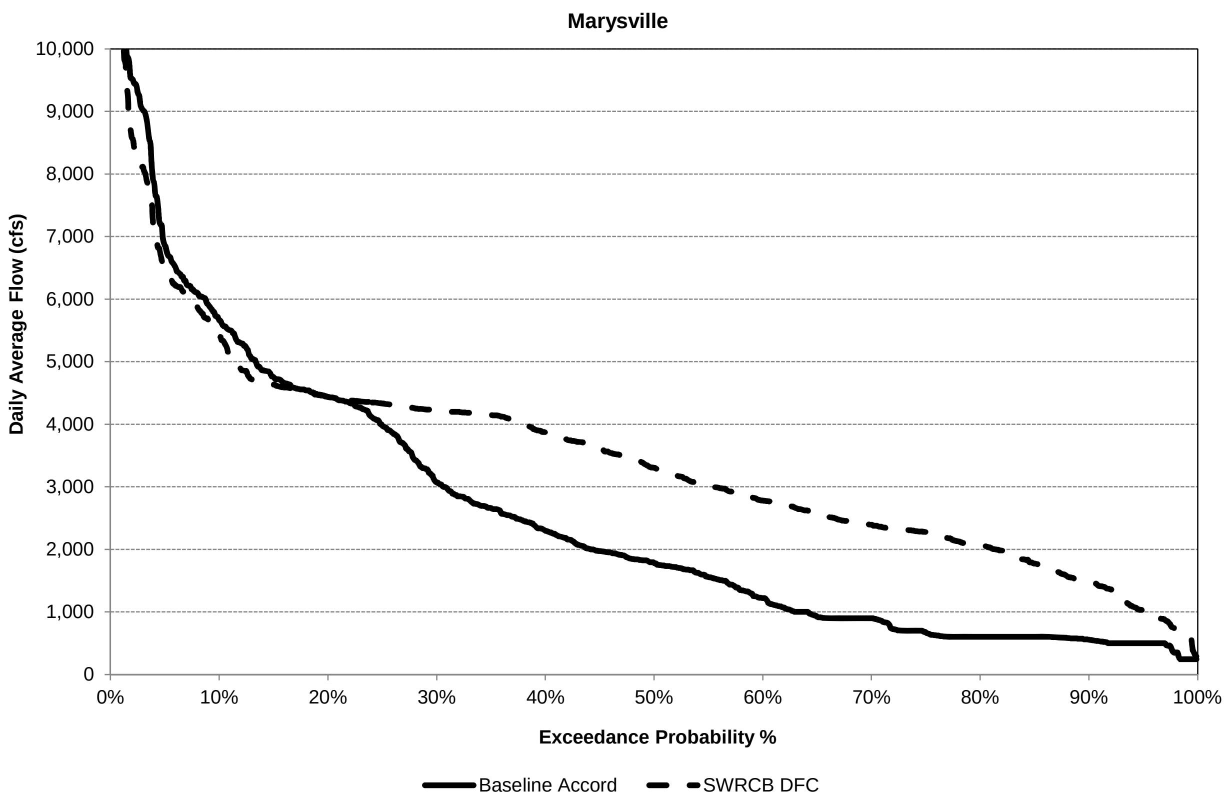



Exceedance Probability of Flow in March
Smartville
Daily Average Flow (cfs)
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance Probability %
Baseline Accord
SWRCB DFC

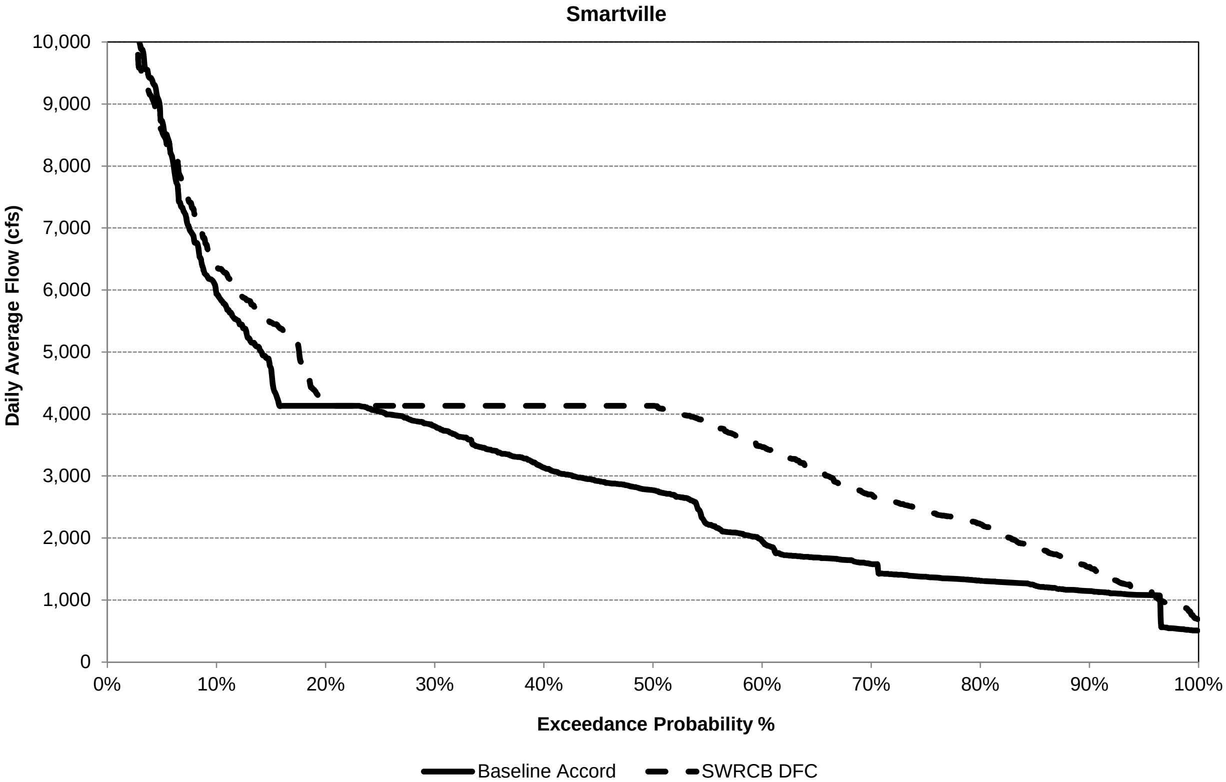

Marysville
Daily Average Flow (cfs)
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance Probability %
Baseline Accord
SWRCB DFC

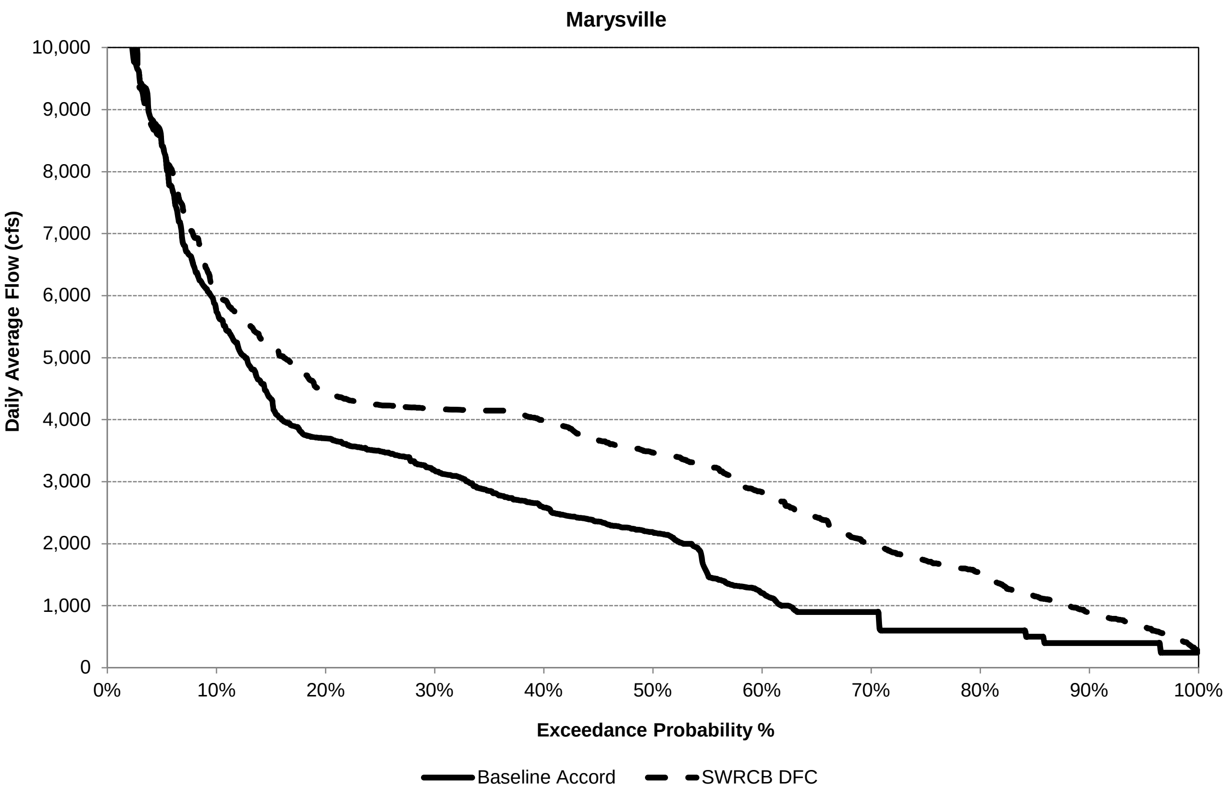
Exceedance Probability of Flow in April



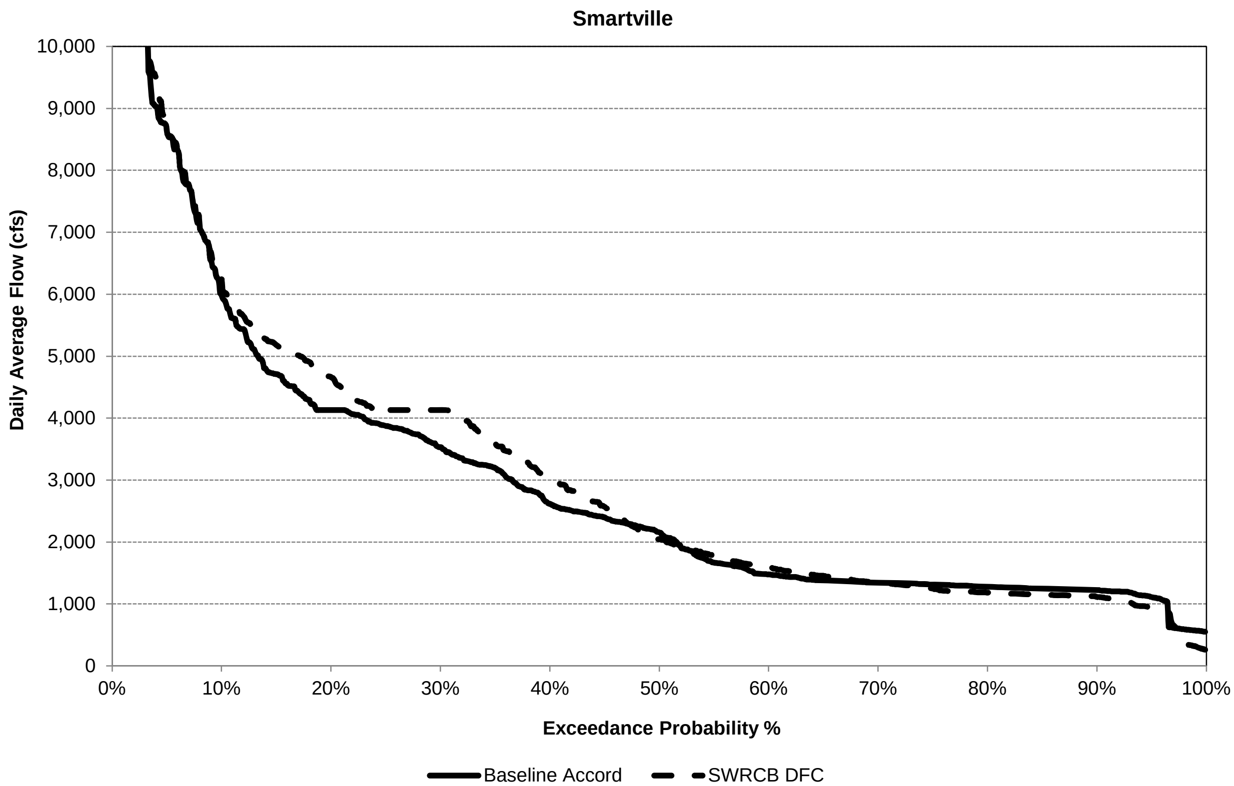


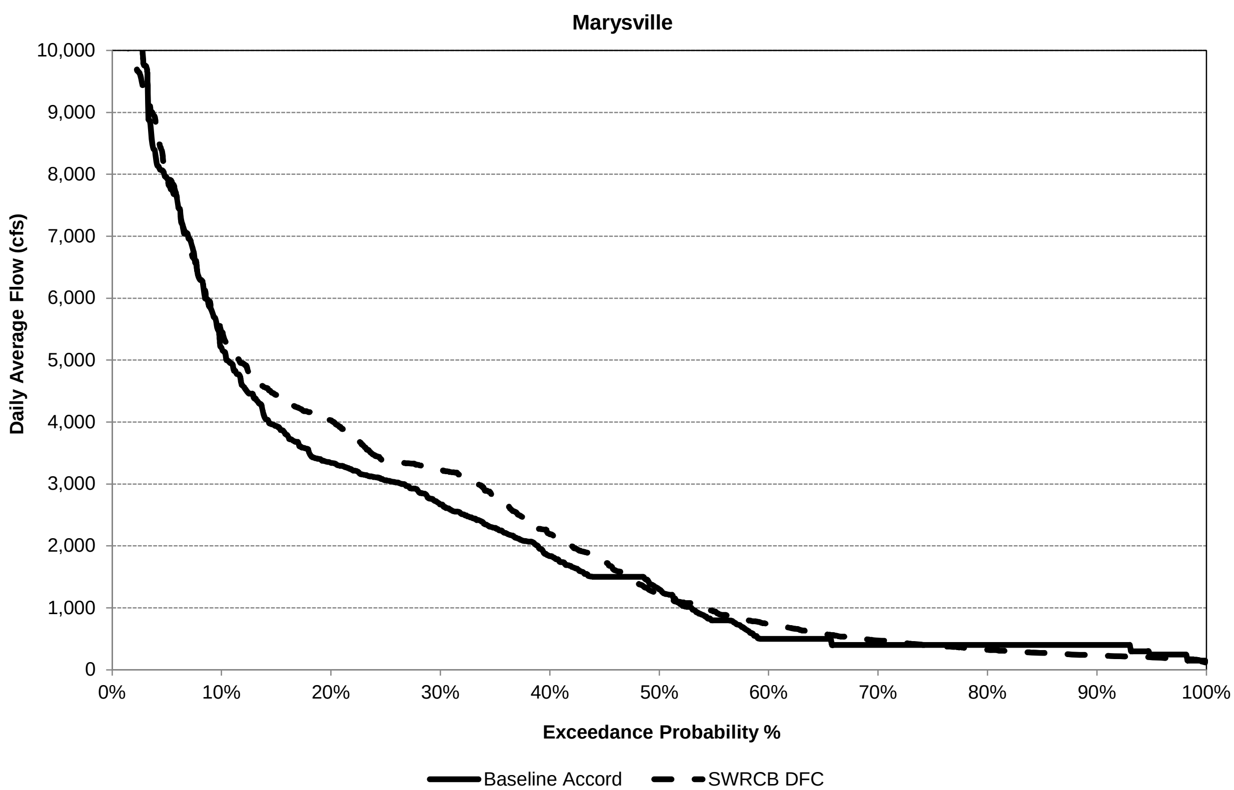
Exceedance Probability of Flow in May



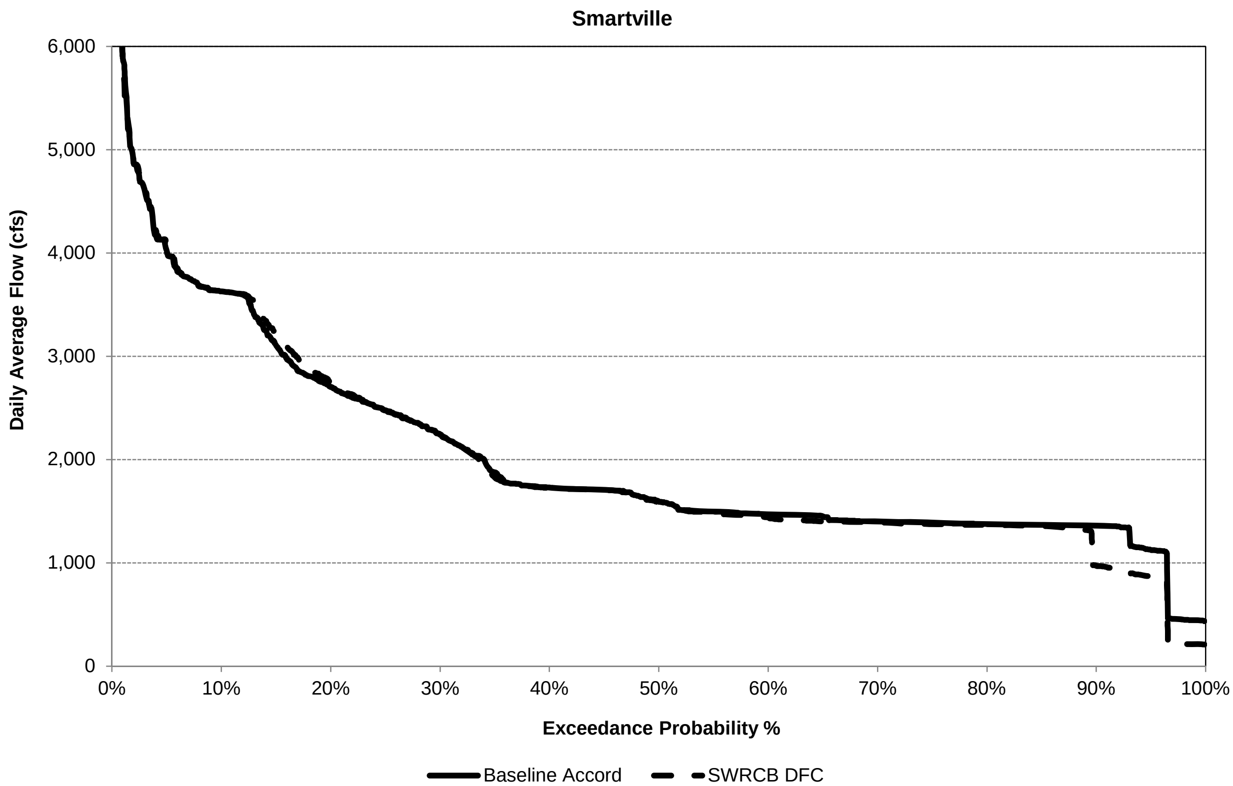


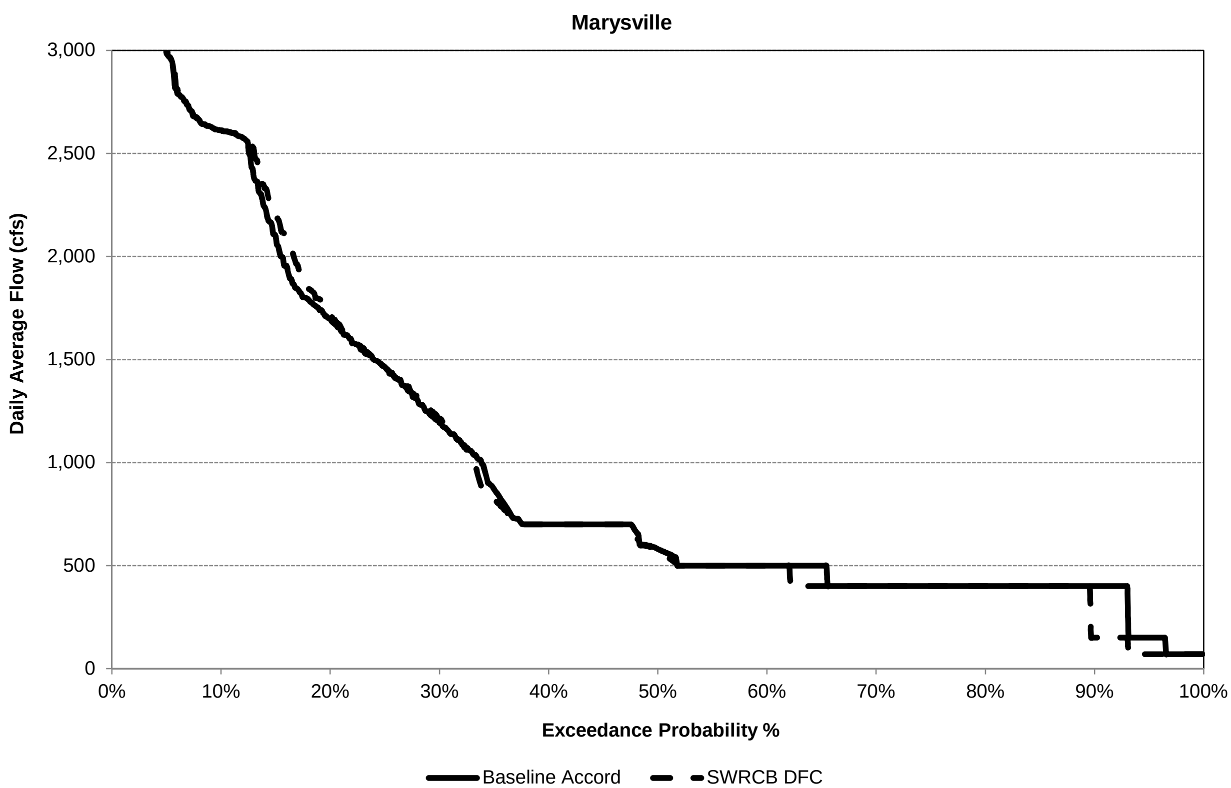
Exceedance Probability of Flow in June



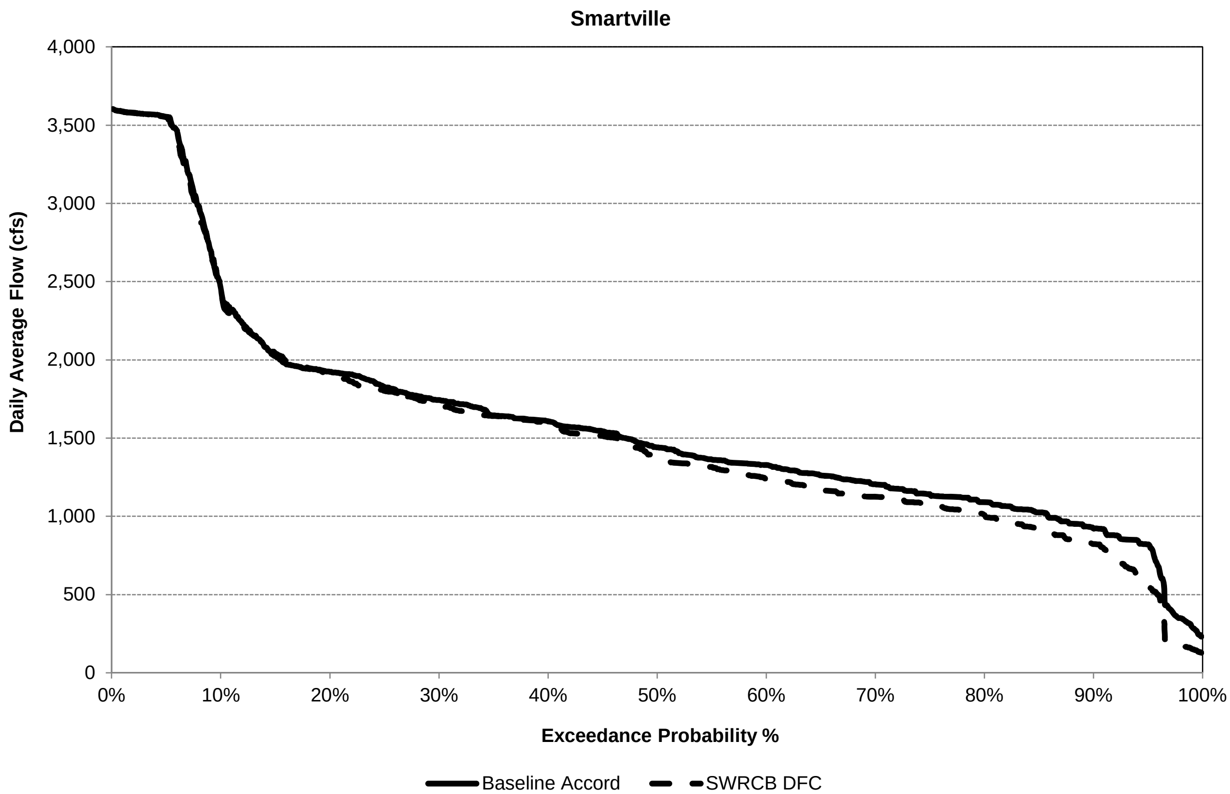


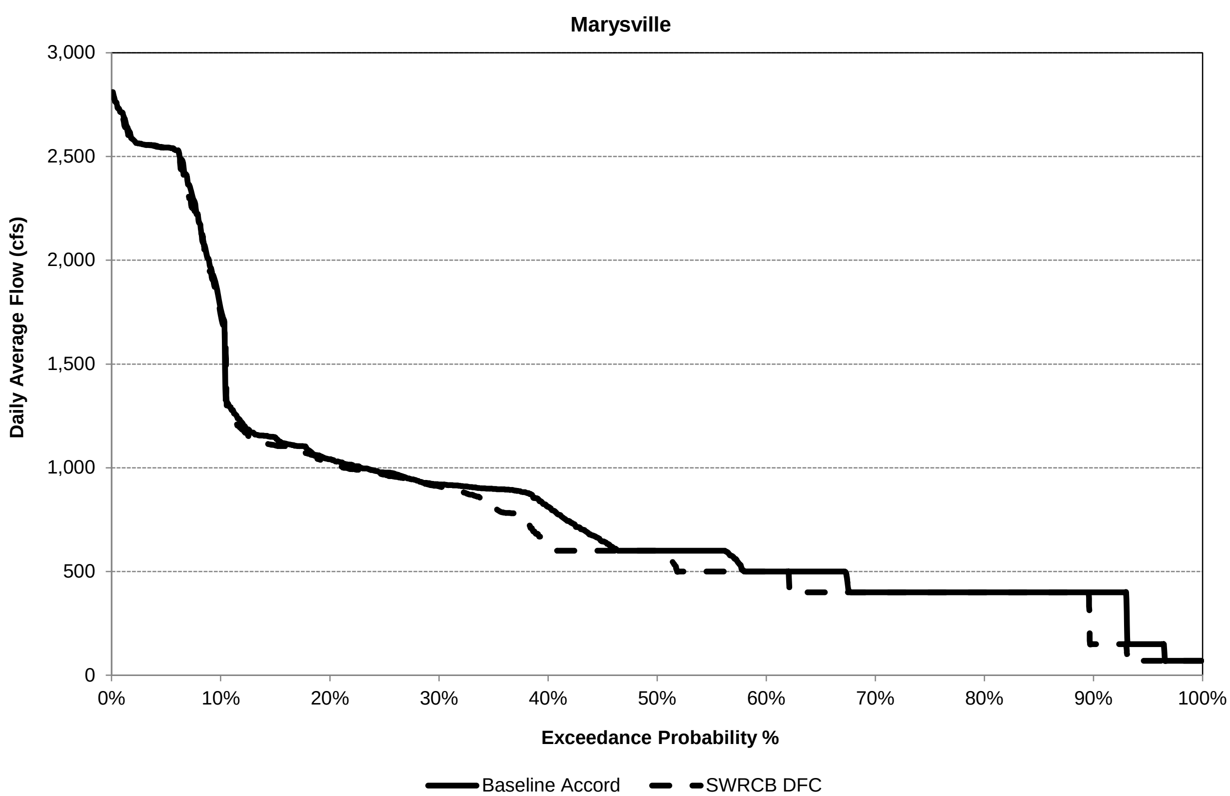
Exceedance Probability of Flow in July





Exceedance Probability of Flow in August





Exceedance Probability of Flow in September